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[Committee] Special Committee
on Science Policy
Proceedings



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First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

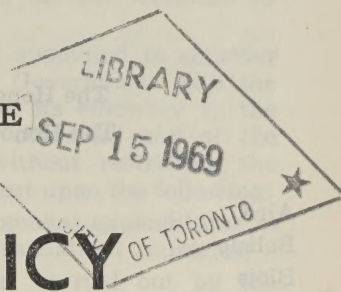
PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY



The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 46 -60

WEDNESDAY, MAY 28TH, 1969

WITNESSES:

Dr. Maurice l'Abbé, Vice-Rector (Research), University of Montreal, Montreal, Quebec; Dr. S. B. Frost, Dean of the Faculty of Graduate Studies, and Research, McGill University, Montreal, Quebec; Professor H. M. M. Dutton, Head, Physics Department, Bishop's University, Lennoxville, Quebec; Dr. D. J. McDougall, Chairman, Geotechnical Sciences Department, Loyola College, Montreal, Quebec; Dr. J. R. Ufford, Assistant Dean of Science, Sir George Williams University, Montreal, Quebec; Dr. Larkin Kerwin, Vice-Rector (Research), Laval University, Quebec, Quebec; Dr. R. E. Bell, Vice-Dean, Faculty of Arts & Science, McGill University, Montreal, Quebec.

APPENDICES:

No. 67.—Joint brief submitted by Laval University, University of Montreal and the University of Sherbrooke.

No. 68.—Brief submitted by the Faculty of Engineering, Loyola College.

No. 69.—Brief submitted by the Faculty of Science, Loyola College.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

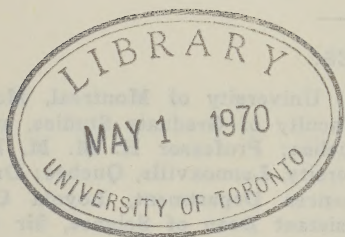
The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.



ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

“With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand, and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, May 28, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Bourget, Cameron, Carter, Grosart, Haig, Hays, Kinnear and Robichaud.—(11)

In attendance: Philip J. Pocock, Director of Research (Physical Science), Gilles Paquet, Director of Research (Human Science).

The following witnesses were heard:

- Dr. Maurice L'Abbé, Vice-Rector (Research), University of Montreal, Montreal, Quebec;
- Dr. S. B. Frost, Dean of the Faculty of Graduate Studies and Research, McGill University, Montreal, Quebec;
- Professor H. M. M. Dutton, Head, Physics Department, Bishops University, Lennoxville, Quebec;
- Dr. D. J. McDougall, Chairman, Geotechnical Sciences Department, Loyola College, Montreal, Quebec;
- Dr. J. R. Ufford, Assistant Dean, Faculty of Science, Sir George Williams University, Montreal, Quebec;
- Dr. Larkin Kerwin, Vice-Rector (Research), Laval University, Quebec, Quebec, and
- Dr. R. E. Bell, Vice-Dean, Faculty of Arts and Science, McGill University, Montreal, Quebec.

(A curriculum vitae of each witness follows these Minutes)

The following are printed as appendices:

- No. 67.—Joint brief submitted by Laval University, Quebec, Quebec, the University of Montreal, Montreal, Quebec, and the University of Sherbrooke, Sherbrooke, Quebec.
- No. 68.—Brief submitted by the Faculty of Engineering, Loyola College, Montreal, Quebec.
- No. 69.—Brief submitted by the Faculty of Science, Loyola College, Montreal, Quebec.

At 12.55 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Bell, Robert E. Born 29 November 1918 in England of Canadian parents: lived in Canada since infancy. Education: Elementary and High School in Ladner, B.C. (near Vancouver). University of British Columbia, 1935-1941: B.A. in Honours Mathematics and Physics, 1939. M.A. in Physics, 1941. Three scholarships. McGill University, 1945-1946 in residence, 1946-1948 working on research: Ph.D. in Physics, 1948. N.R.C. Fellowship, 1945-1946. Employment: 1941-1945—Wartime research and development of radar, National Research Council, Ottawa. 1946-1952—Nuclear Physics research at the Atomic Energy Projects, Chalk River Laboratories. 1952-1956—On loan from Chalk River Laboratories to Radiation Laboratory (now J. S. Foster Radiation Laboratory), Physics Department, McGill University, as Research Associate. Left the employ of Chalk River in September 1956 with the rank of Senior Research officer. 1956-1958—On staff of Physics Department, McGill University, as Associate Professor. 1958-1959—Spent a year of work and study at Niels Bohr's Institute for Theoretical Physics, Copenhagen. 1960—Appointed Rutherford Professor of Physics, and Director of the Foster Radiation Laboratory, McGill University. 1964-1967—Vice-Dean for Physical Sciences, McGill University. Memberships and Distinctions: Fellow of the Royal Society (London) 1965. Fellow of the Royal Society of Canada 1955 and Secretary of Section III (Science) 1962-1964. Fellow of the American Physical Society 1954; Councillor 1965-1967. President of the Canadian Association of Physicists 1965-1966; C.A.P. Medal for Achievement in Physics 1968. Member of the Society of the Sigma Xi. Member of the Canadian National Committee of the International Union of Pure and Applied Physics and Corresponding Member of the Commission on low Energy Nuclear Physics. Canadian Centennial Medal 1967.

Theses, Publications, and Patents:

1. *Theses*: "On the Ultraviolet Spectrum of the Hydrogen-Deuterium Molecule" (M.A. Thesis, University of B.C., 1941). "Gamma Rays of Neutron Capture Studied with the Beta Ray Spectrometer" (Ph.D. Thesis, McGill University, 1948).

2. *Publications* (names of co-authors given in parentheses where applicable): "Disintegration Scheme of 1.7 Year Cesium 134", (with L. G. Elliott). Physical Review 72, 979 (1947). "Experimental Upper Limit for the Mean Life of the 478.5 keV Excited State of Lithium 7", (with L. G. Elliott). Physical Review 74, 1869 (1948). "Lifetime of the 479 keV Excited State of Lithium 7", (with L. G. Elliott). Physical Review 76, 168 (1949). "Gamma Rays from the Reaction $H^1(n,\gamma)D^2$ and the Binding Energy of the Deuteron", (with L. G. Elliott). Physical Review 74, 1552 (1948) and Physical Review 79, 282 (1950). "Search for a 3.20 MeV Gamma Ray in the Disintegration of Thorium C'", (with L. G. Elliott). Can J. Research A26, 379 (1948). "Upper Limit for the Lifetime of the 411-keV Excited State of ^{198}Hg ", (with H. E. Petch). Physical Review 76, 1409 (1949). "Measurement of a 1.6×10^{-9} Second Half-Life in ^{170}Yb ", (with R. L. Graham). Physical Review 78, 490 (1950). "Half Lives of Excited States of ^{106}Hg , ^{131}Xe , and ^{198}Hg ", (with R. L. Graham). Physical Review 84, 380 (1951). "Design and Use of a Coincidence Circuit of

Short Resolving Time", with R. L. Graham and H. E. Petch). *Can. J. Physics* 30, 35 (1952). "Disintegration Scheme of ^{131}I ", (with R. L. Graham). *Physical Review* 86, 212 (1952). "Wide Range Logarithmic Radiation Meter", (with R. L. Graham). *Review of Scientific Instruments* 23, 201 (1952). "The Disintegration of ^{170}Tm ", (with R. L. Graham and J. L. Wolfson). *Can. J. Physics* 30, 459 (1952). "The Determination of the Half Lives of Some Magnetic Dipole Gamma Ray Transitions", (with R. L. Graham). *Can. J. Physics* 31, 377 (1953). "Time Distribution of Positron Annihilation in Liquids and Solids", (with R. L. Graham). *Physical Review* 90, 644 (1953). "Search for a Possible Error in the Measured Half Life of ^{198}Au ", (with L. Yaffe). *Can. J. Physics* 32, 416 (1954). "The Thermal Neutron Capture Cross Section of ^{198}Au and the Half-Life of ^{198}Au ", (with R. L. Graham and L. Yaffe). *Can. J. Physics* 33, 457 (1955). "Nuclear Particle Detection: Fast Electronics" (*Annual Reviews of Nuclear Science*, Stanford, California, Vol. IV, 1954). "Measurement of Short Lifetimes", "Disintegration of Iodine 131", "Annihilation of Positrons in Liquids and Solids (Chapters in Beta- and Gamma-Ray Spectroscopy, K. Sieghahn, editor, North-Holland Publishing Co., Amsterdam, 1955). "The Resolver, A Circuit for Reducing the Counting Losses of a Scaler", *Can. J. Physics* 34, 563 (1956). "Cross Sections of (p,xn) Reactions in the Isotopes of Lead and Bismuth", (with H. M. Skarsgard), *Can. J. Physics* 34, 745 (1956). "Variations in the Amounts of Positronium Formed in Liquids and Amorphous Solids", (with R. E. Green). *Can. J. Physics* 35, 398 (1957). "Notes on a Fast Time-to-Amplitude Converter", (with R. E. Green). *Nuclear Instruments* 3, 127 (1958). "Genetic Measurement of the Half Life of ^{207}Bi ", (with J. Sosniak). *Can. J. Physics* 37, 1 (1959). "Half Lives of First Excited States of Even Nuclei of Em, Ra, Th, U, and Pu", (with S. Bjørnholm and J. C. Severiens). *Matematiskfysiske Meddelelser, Kongelige Danske Videnskabsnernes Selskab* 32, no. 12 (1960). "The Half Life of the First Excited State of ^{208}Tl ", (with E. S. B. Pederson). *Nuclear Physics* 21, 393 (1960). "Method of Evaluating Delayed Coincidence Experiments", (with R. S. Weaver). *Nuclear Instruments and Methods* 9, 149 (1960). "More Power for McGill Cyclotron", *Canadian Nuclear Technology* 1, no. 2, 31 (1961). "Higher Order Events in Coincidence Counting". *Nuclear Instruments and Methods* 12, 199 (1961). "Cross Sections of (p,pxn) Reactions in ^{197}Au ", (with T. M. Kavanagh). *Can. J. of Physics* 39, 1172 (1961). "A Simple and Accurate Method for Calibrating Nanosecond Time-to-Pulse-Height Converters", (with R. L. Graham, J. S. Geiger, and R. Barton). *Nuclear Instruments and Methods* 15, 40 (1962). "Dependence of Line Widths of Scintillation Counters on Integrating Time Constant", (with P. Onno). *Nuclear Instruments and Methods* 17, 149 (1962). "McGill Discovers New Type of Radioactivity", (with R. Barton and R. McPherson). *Canadian Nuclear Technology* 3, no. 3 (1963). "Observation of Delayed Proton Radioactivity", (with R. Barton, R. McPherson, W. R. Frisken, W. T. Link, and R. B. Moore). *Can. J. Physics* 41, 2007 (1963). "Delayed Proton Emission Following the Decay of ^{23}Ne ", (with R. McPherson and J. C. Hardy). *Physics Letters* 11, 65 (1964). "Coincidence Techniques and the Measurement of Short Mean Lives", Chapter 17 of *Alpha, Beta, and Gamma Ray Spectroscopy*, K. Siegbahn, editor, North-Holland Publishing Co., 1964. "Three Problems on Random Events", *Am. J. Physics* 33, 219 (1965). "Decay of Carbon-9", (with J. C. Hardy and R. I. Verrall), *Physical Rev. Lett.* 14, B553 (1965). "New Information on the Emission of Delayed Protons Following the Decay of ^{13}Ne , ^{23}Mg , and ^{28}Si ", (with J. C. Hardy). *Can. J. Physics* 43, 1671 (1965).

"J. S. Foster, 1890-1964", Proc. Roy. Soc. Can., Fourth Series, Vol. III, 101 (1965). "Superaligned log *ft* Values for Transitions Between $T=3/2$ Analogue States", (with J. C. Hardy and R. I. Verrall). Nuclear Physics 81, 113 (1966). "An Extended Nomogram for log *ft* Values", (with R. I. Verrall and J. C. Hardy). Nuclear Instruments and Methods 42, 258 (1966). "Comparison of Leading-Edge and Crossover Timing in Coincidence Measurements". Nuclear Instruments and Methods 42, 211 (1966). "J. S. Foster, 1890-1964", Biog. Memoirs Fellows R.S. 12, 147 (1966). "Statistics of a Two-Parameter Analyzer with Associative Memory", Nuclear Instruments and Methods 50, 258 (1967). "Proton Radioactivity", Encyclopaedic Dictionary of Physics, J. Thewlis, ed., Pergamon Press, 1968. "Direct Measurement of the Primary Photoelectron Yield in Sodium Iodide Scintillation Counters" (with A. Houdayer and S. K. Mark). Nuclear Instruments and Methods 59, 319 (1968). "Square Root Graph Paper for Nuclear Spectra" (with R. I. Verrall). Nuclear Instruments and Methods, accepted for publication in 1968.

3. *Patents*: "Coincidence Circuit", U.S. Patent no. 2,610, 303 (issued September 9, 1952). (Also Canadian Patent issued 1953).

Dutton, H. M. Born August 13, 1919 at Prescott, Lancashire, England. Graduated in 1940 from University of London with a B.Sc. Served in Royal Air Force from 1940-1946, Technical Branch (Signals), including two years in Canada on loan to R.C.A.F. Retired with rank of Flight Lieutenant. Returned to Canada in 1946 and took M.Sc. (with Honours) in Physics at the University of Western Ontario in 1947. Senior demonstrator, University of Western Ontario 1947-48; Lecturer in Physics department University of British Columbia 1948-49; Assistant Professor, Canadian Services College, Royal Roads, B.C. 1949-61; Professor, Bishop's University, Lennoxville, Québec 1961 becoming Head of Department in 1965. Married Joan Brock of Winnipeg, Manitoba on December 26, 1942; 3 children.

Frost, Stanley Brice, born London, England, 17th February, 1913. Educated: Aske's Haberdashers' Hatcham School 1926-32 (Captain of the School, 1931-32). Richmond College, London University. 1932-36) Marburg University (Dr. Williams' Scholar) 1936-37. Degrees: B.D. London 1936; Dr. Phil. Marburg 1938; M.Th. (Biblical and Historical Theology) 1943; Hon. D.D. Victoria, Toronto 1963; Hon. D. Litt. Memorial, 1967. Ordained British Methodist Conference, 1939; pastorates in London and Stoke-on-Trent 1939-49; Chair of Old Testament Languages and Literature, Didsbury College, Bristol 1949-56; Special Lecturer in Hebrew, Bristol University, 1952-56; Professor of Old Testament Studies, McGill University, 1956- ; Dean of Faculty of Divinity 1957-63; Acting Dean of Graduate Studies 1962-63; Dean of Faculty of Graduate Studies and Research 1963- . Chairman of University Press Editorial Committee 1962-69. Chairman of University Libraries' Committee 1963- . President of Canadian Biblical Society 1962-63. President of American Association of Theological Schools 1964-66. President of Canadian Association of Graduate Schools 1964-65. Member, Executive Committee, Association of Graduate Schools in the Association of American Universities, 1967-69. Member, Graduate Record Examinations Board 1967; 68-72. Member, Committee on Rationalisation of Major Library Holdings (A.U.C.C.) 1969. Member, Council of Graduate Schools in the United States, Humanities Conference, 1969. A. Major Publications: *Die Autoritätslehre in den Werken John Wesleys*, Munich, Ernst Reinhardt, 1938, 112 pp. *The Pattern*

of *Methodism*, Methodist Youth Department, London, 1948, reprinted 1952, 109 pp. *Old Testament Apocalyptic, Its Origins and Growth*. The Fernley-Hartley Lecture for 1952, London, Epworth Press, xiii and 270 pp. *The Beginning of the Promise, Eight Lectures on Genesis*, London, S.P.C.K., 1960, 98 pp. *Patriarchs and Prophets*, Montreal, McGill University Press, and London, John Murray, 1963, vii and 231 pp. *Standing and Understanding; a Reappraisal of the Christian Faith*. The Arthur Samuel Peake Lecture for 1968. London, Epworth Press and Montreal, McGill University Press, 1969, 187 pp. *Commentaries on Jeremiah, Baruch, The Letter of Jeremiah, The Prayer of Monasses in The Revised Abingdom Commentary*, Nashville (to be published 1969). B. Papers: 1. "Eschatology and Myth", *Vetus Testamentum*, Vol. II, No. 1, 1952, pp. 70-80. 2. "The Christian Theology of the Old Testament", *The London Quarterly*, July 1952, pp. 185-191. 3. "The Authority of the Bible", *The London Quarterly*, April 1954, pp. 90-95. 4. "History and the Bible", *Canadian Journal of Theology*, Vol. 3, April 1957, pp. 87-96. 5. "Asseveration by Thanksgiving", *Vetus Testamentum*, Vol. VIII, No. 4, 1958, pp. 380-390. 6. "Visions of the End: Prophetic Eschatology", *Canadian Journal of Theology*, Vol. 5, No. 3, 1959, pp. 15-16. 7. "The Christian Interpretation of the Psalms", *Canadian Journal of Theology*, Vol. 5, No. 1, pp. 25-34, 1959. 8. "Psalm 139: An Exposition", *Canadian Journal of Theology*, Vol. 6, No. 2, April 1960, pp. 113-122. 9. "Towards a Biblical Doctrine of Holy Communion", *Canadian Journal of Theology*, Vol. 7, No. 1, 1960, pp. 20-31, and *The London Quarterly*, January 1962, pp. 45-55. 10. "Israel's Wisdom Literature", *The Preacher's Handbook*, No. 7, 1961, pp. 31-56. 11. "Psalm 118: An Exposition", *Canadian Journal of Theology*, Vol. 7, 1961, pp. 155-66. 12. "The Role of Myth", *The London Quarterly*, October 1962, pp. 246-252. 13. "Psalm 22: An Exposition", *Canadian Journal of Theology*, Vol. 8, 1962, pp. 102-105. 14. "The Ph.D. Degree", *Bulletin of Education Procedures*, No. 11, February 1967. 15. "Judgement on Jezebel, or A Woman Wronged", *Theology Today*, Vol. xx, No. 4, January 1964, pp. 503-517. 16. "The Theologian and Contemporary Thought", *Theological Education*, Vol. 1, No. 1, July 1964, pp. 3-14. 17. "Apocalyptic and History" in *The Bible and Modern Scholarship*, papers read at the 100th meeting of the Society of Biblical Literature, ed. J. Philip Hyatt, Abingdon Press, New York, 1965, pp. 98-113. 18. "Reviewing Some Foundations", in *Horizons of Theological Education*, ed. J. Ziegler, Dayton 1966, pp. 23-34. 19. "The Death of Josiah", *The Journal of Biblical Literature*, Vol. LXXXVII, Part IV, 1968, pp. 369-382. 20. (with R. F. Schnell) *The Psalter Arranged for Christian Worship*. A new Selection, Text and Arrangement, commissioned by the United Church of Canada. (accepted and gone to Printer—to be published in 1969.) C. Contributions to: *The Interpreter's Dictionary of the Bible* (1962); *Hasting's Dictionary of the Bible* (1963); *Encyclopedia Britannica* (1963 and 1965); *The Manchester Guardian*; *The Gazette* (Montreal). D. Reviews: *Canadian Journal of Theology*; *Theology Today*; *Theology*.

Larkin Kerwin. Born in Quebec, June 22, 1924; married Miss Lupita Turcot, June 10, 1950; seven children. Studies: Engineering Certificate, St. Francis Xavier University, 1943; B.Sc. (summa cum laude) St. Francis Xavier University, 1944; M.Sc. (magna cum laude) Massachusetts Institute of Technology, 1946; D.Sc. (magna cum laude) Laval University, 1949. Profession: Professor of Physics. Academic Status: Lecturer, St. Francis Xavier University, 1944; Lecturer, University of Toronto, 1945; Research Physicist, The Geotechnical Corporation, Cambridge, 1945; Assistant Professor, Laval University, 1946;

Lecturer, Laval University, 1948; Agrégé Professor, Laval University, 1951; Titular Professor, Laval University, 1956; Director of the Physics Department, Laval University, 1961-1967; Director of the Mass Spectrometry Research Laboratory, Laval University, 1955-1966; Vice-Dean of the Faculty of Sciences of Laval University, 1967-1968; Vice-Rector of Laval University, 1969. Scientific or Professional Associations: French-Canadian Association for the Advancement of Sciences; Canadian Association of Physicists (Vice-President in 1953-54, President in 1954-1955); American Physical Society; Canadian Association of University Teachers; International Union of Pure and Applied Physics (Assistant Secretary-General, 1963-); Corporation of Professional Engineers of Quebec; Royal Society of Canada (Chairman of the Physics Section, 1967); Canadian Joint Research Organization (Vice-President, 1967-). Other Spheres of Activity: Founding Physicist of the Radioisotope Clinic (Quebec area); Governor of St. Lawrence College; Chairman of the Advisory Committee on Electronic Research, Defence Research Board of Canada (1959-1963); Member of the Physics Grants Committee, National Research Council of Canada (1956-1962, 1966-); Committee on the State of Physics in Canada and Medal Committee, Canadian Association of Physicists (1958-1963); Vice-President of the United Nations Association (Quebec section) (1958-1959); Member of the Cercle Universitaire, Quebec; Founding President of the Catholic Parents' Association of Sillery; Member of the Grant Selection Committee of the National Research Council; Member of the Grant Selection Committee of the Department of Education of the Province of Quebec; President of Expo-Sciences of Canada for the 1967 Centennial; Assistant Editor of the Canadian Journal of Physics, 1968- . Honorary Medals: Lieutenant Governor's Medal in 1941; Governor General's Medal in 1944; Prizewinner in the Literary and Scientific Competitions of the Province of Quebec, Prix David in 1951; Médaille Pariseau of the F.C.A.A.S. in 1965; Member of the Royal Society of Canada; 1967 Centennial Medal; Medal of the Canadian Association of Physicists, 1969. Research: Research in atomic and molecular physics: Mass spectrometry; Ionization, dissociation and vibration energy; Study of molecular structure using an electron selector; Ion optics; High energy beam spectroscopy.

Publications: 1. "Use of the Broadcast Band in Geologic Mapping" J. Appl. Phys. 18, 407-413 (1947). 2. "Improved Magnetic Focusing of Charged Particles" Rev. Sci. Instr. 20, 36 (1949). 3. "Further Improvements in Magnetic Focusing" (with C. Geoffrion) Rev. Sci. Instr. 20, 381-386 (1949). 4. "A New Type Mass Spectrometer" Rev. Sci. Instr. 21, 96-97 (1950). 5. "La dose tolérable de radiation" Laval Médical, 16, April (1951). 6. "The Maximum Permissible Exposure of Radiation—I" J.C.A.R. 2, 21-23 (1951). 7. "The Maximum Permissible Exposure to Radiation—II" J.C.A.R. 2, 38-41 (1951). 8. "Note on the Resolving Power of Mass Spectrometers" Can. J. Phys. 30, 503-511 (1952). 9. "Some Mass Spectrometric Data on Phosphorus" Can. J. Phys. 32, 757-758 (1954). 10. "La nature des isotopes" Laval Médical, 19, March (1954). 11. "Mass Spectrometry" Adv. in Elect. and Elec. Physics, VIII (1956). 12. "Le Cobalt 60, agent thérapeutique" Le Livre de l'année (Grolier) (1956). 13. "Some Upper Limits of Isotopic Abundance—I: A, Mn, Cd" Can. J. Phys. 34, 1080-1081 (1956). 14. "Some Upper Limits of Isotopic Abundance—II: Na, Cl, Ga" (with D. McElcheran) Can. J. Phys. 34, 1497 (1956). 15. "Some Upper Limits of Isotopic Abundance—III: C, O, Zn" (with D. McElcheran and M. Cottin) Can. J. Phys. 35, 783-784 (1957). 16. "Mass Spectrometric Analysis of Some Hydrogen Oxides—I" (with M. Cottin) Can. J. Phys. 36, 184-191

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L'Abbé, Maurice. Born in Ottawa, Canada, May 20, 1920. Marital State: Married, 4 children. Education: B.A., University of Montreal, 1942; L.Sc. (Mathematics), University of Montreal, 1945; M.A., Princeton University, Princeton, New Jersey, 1947; Ph.D., Princeton University, Princeton, New Jersey, 1951. Academic Career: 1943-45 Lecturer, Faculty of Science, University of Montreal; 1945-50 Assistant Professor, Faculty of Science, University of Montreal; 1950-56 Associate Professor, Faculty of Science, University of Montreal; 1956- Full Professor, Faculty of Science, University of Montreal; 1957-68 Director, Mathematics Department, University of Montreal; 1964-68 Vice-Dean, Faculty of Science, University of Montreal; 1968 Vice-Rector in Charge of Research, University of Montreal. Academic Awards and Distinctions: Royal Society of Canada Research Fellowship, University of Paris, 1952-53. Invited lecturer, Faculty of Science, University of Paris, 1953. Province of Quebec Prize for Science, 1954. Invited member of the Logic Institute, Cornell University, Ithaca, N.Y., from July 1 to August 2, 1957. Invited speaker and official Canadian delegate at the Réunion des Mathématiciens d'Expression latine, Nice, France, September, 1957. Invited by the France-Canada Scientific Institute to lecture at a number of universities in France (Grenoble, Marseilles, Montpellier), May, 1965. Other Positions and Responsibilities: Vice-President of the Canadian Association of University Professors, 1958-60. Member of the Executive Committee of the Groupement des Mathématiciens d'Expression latine since its establishment in 1959. Founder and Director of the Advanced Mathematics Seminar, 1962-. Secretary of the Associate Committee on Pure and Allied Mathematics of the National Research Council of Canada, 1963-66. President of the French-Canadian Association for the Advancement of Science, 1964-65; Chairman of the Board, 1963-65. Member of the Academic Panel of the Canada Council since 1965. Member of the University Education Commission of the Upper Council on Education, 1965-70. Elected representative of the University Assembly on the Board of Governors of the University of Montreal, 1967-68. Elected representative of the Assembly of Professors of the Faculty of Science on the University Assembly of the University of Montreal. President of the Mathematics Society of Canada, 1967-69. Published Works: 1. Signed commentaries in the *Journal of Symbolic Logic* from 1947 to 1959. 2. "On the independence of Henkin's axioms for fragments of the propositional calculus", *Journal of Symbolic Logic*, Vol. XVI (1951), pp. 43-45. 3. "Systems of transfinite types involving conversion", *Journal of Symbolic Logic*, Vol. XVIII (1953), pp. 209-224. 4. "La théorie des fonctions récursives et la logique mathématique", Faculty of Science, University of Paris (1953), 17 pp. 5. "Structures algébriques suggérées par la logique mathématique", *Bulletin of the Mathematics Society of France*, Vol. 86 (1958), pp. 299-314. 6. "Mathématiques contemporaines", *Liberté*, Vol. 3 (1961), pp. 483-485. 7. "L'Université dit non

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McDougall, David J. 1. Degrees held: B.Sc., McGill University, 1948, Geology. M.Sc., McGill University, 1949, Geology. Ph.D., McGill University, 1952, Geology. 2. Experience—Academic and/or Research in past 5 years: 1963-1967, Assoc. Prof. (and Dept. Chairman), Geotechnical Sc., Loyola College, Montreal. 1966-1967 (Sabbatical year) Research Scientist, Société Québécoise d'Exploration Minière. 1967-1968, Professor (and Dept. Ch.) Geot. Sc., Loyola College. 1963-1968, Continuing research on thermoluminescence and allied solid state phenomena of geological materials. Author of numerous papers on thermoluminescence of minerals and rocks. Editor: "Thermoluminescence of Geological Materials," (Academic Press) London. 1968. (Proceedings of N.A.T.O. Advanced Research Institute, Spoleto, Italy, 1966). Recipient of research grant from N.R.C., G.S.C., D.R.B.

Ufford, John R., B. Eng., M.A. Sc., Ph.D., M.C.I.C. Dr. Ufford was born in Cardinal, Ontario, in 1921. He received the B. Eng. degree in chemical engineering from McGill University in 1943. From 1943 to 1946 he was chief chemist for the Nicholls Chemical Co. in Sulphide, Ontario. From 1946 to 1949 he was a lecturer in the Faculty of Applied Science and Engineering at the University of Toronto. He received the M.A.Sc. degree in 1949 from the University of Toronto. In 1949 he joined the staff of the Chemistry Department at Sir George Williams University in Montreal. In 1960 he received the Ph.D. from McGill University. In 1964 he was appointed Chairman of the Chemistry Department of Sir George Williams University and 1968 he was appointed Assistant Dean of the Faculty of Science. He is a member of the Chemical Institute of Canada of which he is presently a councillor and the American Chemical Society.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, May 28, 1969

The Special Committee of the Senate on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

[*Translation*]

The Chairman: Honourable Senators, we have the honour this morning of welcoming the representatives of the Quebec universities. We shall proceed, as we did yesterday, by first asking the delegations of each of the universities to make a short introductory statement.

First, I should like to call upon Dr. Maurice L'Abbé. I asked Dr. L'Abbé to somewhat prolong his statement to approximately ten minutes as Dr. L'Abbé will speak on behalf of Laval University, the University of Montreal and the University of Sherbrooke. Following this, we shall hear the statements of the other universities, of the other language, in the Province of Quebec.

Senator Bourget: Mr. L'Abbé is from the University of Sherbrooke?

The Chairman: From the University of Montreal; the representative of the University of Sherbrooke has apparently not arrived yet. At the moment, from the French universities we have Mr. Maurice L'Abbé and Mr. Kerwin from Laval University who also is Vice-Rector in charge of research.

Senator Bourget: And doctor.

The Chairman: Doctor; and now, Dr. L'Abbé.

Dr. Maurice L'Abbé, Vice-Rector (Research), University of Montreal: First, I should like to begin with three rapid comments concerning the brief. As Senator Lamontagne stated, it is a joint brief from the three French-speaking universities in Quebec. Obviously, when we were preparing this combined effort, there were only three French-speaking universities in Quebec. There is now a fourth, the University of Que-

bec, which would have joined us if it had been able, at the time, to partake in our decision.

There were two motives behind the decision to submit a joint brief. First, I feel I must emphasize that it results from the conviction, held by our universities, that all the universities now constitute a complex, an organic unity, where universities are no longer isolated and must essentially co-ordinate and mutually plan their development, particularly at the research level. It was certainly this conviction, in part, which prompted us to submit a joint brief. However, the principal reason is that we feel that common research problems, particularly with regard to a national science policy which may develop, concern the French-speaking universities of Quebec. Needless to say, the idea of a joint brief imposed restraints which have been difficult to surmount and, to a certain extent, this brief represents, therefore, a common denominator of certain views held by our respective universities. It goes without saying, therefore, that, had each of our universities done so separately, they would perhaps have presented slightly different viewpoints. What we have, therefore, are fundamental opinions on the subject under study.

Finally, I should like to make one last comment regarding the position we have taken in our brief. It is obvious that in making recommendations to the Lamontagne Committee on federal research policy, we in no way make predictions regarding the agreements or political changes which may arise between the federal and Quebec governments, or on the constitutional option towards which the Quebec of tomorrow might head. However, in the face of this possibility, we have adopted a realistic and, to some extent, empirical attitude. We confront realities demanding immediate action and have embarked on a study of the present situation by limiting our recommendations to those which we feel may be put into effect under the present political and constitutional system.

I was anxious to make this point to emphasize that this is an attitude common to the three universities in the presentation of this brief.

The brief, essentially, involves three parts. The last is a brief conclusion, or summary.

The first part concerns research and the Canadian society. We therefore attempt to place research in its more general context of the country, of Canada. Briefly, in this part we pointed out that any national scientific policy should take into account the two dimensions of our society, the one being the pluralist nature of this society, the other, the specific nature of its economy.

Regarding the first dimension which we describe as the pluralism of Canadian society, there are perhaps two aspects. First of all, there are the regional disparities in Canada which call for a concerted policy between the federal and provincial governments. In addition to this regional aspect which affects not only science policy but also, as is well known, the economic policy of the country, there are also what one would call cultural disparities. Basically, the cultural plurality of the Canadian society, not to mention its national duality, implies that an overall science policy will not oppose or alter policies which each Canadian cultural community might adopt. The latter aspect, the aspect of cultural disparities, is to some extent complicated by the fact that the French-speaking concentration in Quebec, as we are aware, adds a constitutional and political dimension to this question. Obviously, it is not the purpose of our brief to suggest solutions to the problem or even to analyze it; however, we feel the problem is important and should be studied, provided these particular discussions—the constitutional debate as it is called today—in no way hinder the development of research in Canada in general.

The second characteristic—what we have termed the specificity of the Canadian economy—is well known and I shall not linger over the subject. We must remember, as all do, that our economy is unique in many ways owing to the youth and scantiness of the population spread over a vast expanse of land. We must remember that our economy is essentially subject to many outside influences and, last but not least, that we are the neighbours of a giant, the United States. This specificity of our economy calls for positions which must be reflected in a federal policy. It is clear that at the very minimum we must

plan a balanced development of the various fields of scientific activity essential to any so-called complete society which a country such as Canada must be considered. And yet, this does not appear to be sufficient. In our opinion, a science policy, like any policy, must make choices and benefit to some extent certain areas in keeping with the specificity of our economy. In these chosen areas, we could not only create centres of excellence, but at the same time add an international development to our research effort.

The second section of our brief concerns research in the university. Therefore, in dealing with the particular context which interests us most as university professors, we insist, in this section, on the close and essential relationships between research in the university and teaching. In a way, these are two aspects of the same activity; they are indissociable and mean that the university is not only a centre where research is conducted, but, at the same time, a centre where researchers are trained. The rest of this section emphasizes the need not only for close relations among the universities themselves at the research level, but also between the universities and government research bodies, government or semi-public research laboratories and, finally, private industrial research groups. We feel that these three major sectors, the university, the government and private industry, must co-operate in a research policy, even with regard to the particular goals of the university.

The last and perhaps most important section to our way of thinking places research in the context of the French universities. We are aware that the French-speaking universities have developed more slowly for various reasons which have not always necessarily depended on the English universities. We are also aware that now, from the point of view of quality, the major Quebec universities have attained standards and a development in several areas whereby they compare favourably with their English counterparts in the rest of Canada. We feel, and the facts prove it, that our research workers can now openly compete with their colleagues in the major federal agencies; that the level of graduate studies has almost attained the Canadian average, and that our operating budgets allotted to research have almost reached, or are rapidly reaching, the Canadian average. However, we note that from the point of view of size, from the point of view of extension,

we have largely fallen short of the development we should expect from the French-speaking community.

We give three reasons—and I shall mention these fairly briefly in order to reach the conclusions—which may explain the slower and partial development of research in the French-speaking universities.

The first is that, until recently, grants by federal organizations were made on an individual basis and, as a result, the French-speaking universities in Quebec fared poorly because they had fewer researchers.

The second reason is that, needless to say, federal organizations have been so composed as to ensure to English Canadians, to some extent, the control of the Canadian scientific community. This is reflected, for example, in the composition of the juries, in the composition of the large organizations which are not always completely representative of, let us say, the proportion of scientists which the French community should represent at the national level.

The third point—and this is important—is that the federal government has established an imposing number of regional laboratories or research institutions through its agencies or departments across the country; and the majority of these laboratories are located in an English milieu with the result that access for French Canadians and, particularly, French-speaking persons of other countries, is made difficult. In fact, we note that the amount of subsidies granted by the federal government to the French-speaking universities reveals a fundamental problem. The amount granted to the French universities represents about 11 per cent of the total amount granted to universities across Canada; that is, in 1967-68, the most recent date for which we have exact figures, the French universities received only 11 per cent although, according to population, we should receive more. But what I wish to make clear is that it is not because of population that further grants are justified. It is simply a matter of fact which has its explanations: it is an example of a disparity which must be corrected.

In order to correct this disparity, we recommend—and I will conclude here, Senator Lamontagne, because I think that I have gone well over my ten minutes—that the federal government's policy in the area of research should be realistic and above all, for French-speaking universities, should bring to bear the pluralistic aspect which we have mentioned.

Consequently, we make two recommendations at the end. We suggest that the federal government, through its agencies, should begin at once to take advantage of the possibility for developing Canadian science which is now offered by the staffs of the universities of Montreal and Sherbrooke and of Laval University. We feel that, in five years' time, these universities should become the sites for several large laboratories or centres, preferably, in certain specific cases, through interuniversity or university-government structures.

As our second recommendation, we suggest that the federal government set up research laboratories in Quebec which are French-speaking only and which are closely linked with the universities.

The last section is a conclusion, in which we rapidly review the guidelines which should provide a framework, as it were, for establishing science policy in Canada.

The Chairman: Thank you very much, Dr. L'Abbé. Now that we have heard the spokesman for these three French-speaking universities in Quebec, I am going to ask the spokesmen for the other universities to present their views to us briefly.

[Text]

I would like first to ask Dr. Frost, who is the Dean of the Faculty of Graduate Studies and Research at McGill University, to give us a statement, as I told him, of about five minutes.

Dr. S. B. Frost, Dean of the Faculty of Graduate Studies and Research, McGill University: Thank you very much, Mr. Chairman.

In changing from the one language to the other, it is quite likely that there will indeed be a change not only of accent but also of position. However, obviously, what I have to say is prepared without reference to the remarks we have just heard, and the combination of these two is the concern of the committee.

We welcome this opportunity to make this submission to the committee because we believe that the committee's inquiry is evidence of the federal interest in graduate studies and research in the universities. We think that academic freedom is best preserved and served when the universities are not dependent on one source of Government income only, and, therefore, we welcome the federal presence in the universities at the level of graduate studies and research. This is

a point we made in our brief to the Macdonald committee, and it is one we would like to make again here.

We wish to emphasize strongly the importance to the nation of graduate studies and research, not only in the sciences but also in the humanities and the social sciences. We believe that advanced studies in the humanities act as a leaven, working through academic and governmental and other corporate structures, to maintain and enhance the quality of living, just as technology preserves and advances the standard of living. Research in the humanities and social sciences is not identical with research in the physical and biological sciences, but we believe it to be equally important.

The question is: How should this best be provided for? We have gone on record previously as supporting the proposal that there should be a new social sciences and humanities council, preferably to embrace law also, as distinct from the Canada Council. We are very mindful and appreciative of the helpful role of the Canada Council hitherto, from whom we have indeed derived very great benefits. Nevertheless, we feel that both their history and, in a sense, their commission preclude them from taking the same interest in the universities as institutions as has been traditional with the other councils, the NRC and the MRC. We believe it is in this institutional interest in the universities that NRC and MRC have made such a large contribution on the side of the natural sciences, and we would welcome a council on the humanities and social sciences to take that same kind of interest in these disciplines also.

While we are talking about research in the humanities and social sciences, we wish to stress greatly the need for a national policy with regard to libraries.

We think that the main tendencies of the Macdonald recommendations are along the correct lines. There are some provisos that we would add, and one is that you cannot ask any one library to specialize in a particular area, and in that area only, since all specialization needs strength from contiguous areas, and to ask a library to specialize in one subject only is, as it were, a contradiction in terms. We strongly support the regional strengthening of libraries with the concept of libraries as regional wholes rather than individual units.

We want also to go on record, since we believe it was we who first put the idea for-

ward that the indirect costs of research should be borne by federal funds, seeing that these place a heavy burden on provincial budgets unless this is looked for. We have our own particular approach to this problem, as to how it should be worked out, but we are prepared to accept the Macdonald formula as an alternative. But, we certainly think that indirect research costs should be taken into account.

We also think that a federal policy for graduate studies in research will allow for an intelligent moderation for what must be the prior consideration in all judgments of academic programs, and that is, of course, the academic excellence of the program itself. We think this should be tempered by regional and cultural considerations, and in this respect we support the minority report of Dr. Dugal. We think this is the way in which these interests may best be preserved.

Turning more particularly to the interests of the physical and biological sciences, we want to go on record as saying we believe that research directed towards national objectives or mission-oriented research is not comparable with the research activities of universities. We think that this might possibly get out of hand, but we feel that the academic interests of the universities themselves are enough to ensure that this will not be so. We believe that pure research will not disappear from the universities, and in that regard we think that there is more need than formerly to have a federal agency which identifies and defines those national objectives with regard to which mission-oriented research should be instituted. The activities of the Science Council, in our opinion, point in the correct direction, although they have not yet become sufficiently specific.

We want to go on record as saying that we would not want to see the research laboratories of the National Research Council divorced from the Research Council itself. We think that any awarding body needs itself to be engaged in research, and we think also that this relationship between the laboratories and the universities has proved a two-way street whereby the academic interests of the University have borne upon the Research Council's laboratories, and vice versa.

Lastly, we want to make a very strong plea that nobody takes too much notice of the suggestion in the Macdonald report that graduate students no longer be supported from operating grants of individual research

workers. We believe that this would be a retrograde step, because it would break the close relationship between the professor and his graduate students.

Those of us who administer these things on both sides of the university know what characterizes research on the science side of the university is its close bond between the professor and his students. You do not get this in the humanities and, to a much less degree, in the social sciences. We would deplore more strongly than I have attempted to say at this moment any weakening of that particular tie.

These are the points, Mr. Chairman, that we would wish to make, and in respect to which we shall no doubt be answering your questions.

Merci beaucoup.

The Chairman: Thank you. We shall now hear from Professor Dutton of Bishop's University.

Professor H. M. M. Dutton, Head, Physics Dept., Bishop's University: Mr. Chairman, we did not submit a brief to this committee, so I would like to make a brief statement which will put forward the point of view of Bishop's University, which is a rather special point of view in that Bishop's is a very small university with approximately 1,000 students.

Like other universities we have expanded at what seems to us an incredibly rapid rate. Bishop's is four times bigger today than it was 20 years ago, and many other universities are in exactly the same situation. For Bishop's this is a very large relative change, and the numbers involved are very big. It is only recently that we have reached the kind of threshold where we can contemplate being involved in research programs as opposed to the small efforts made by individual members of the faculty. We would like to do this. We do not contemplate Bishop's being very large. We do not contemplate any expensive doctoral programs, but we would like to generate and sustain programs involving Master's degrees. We think this is essential if we are to continue doing well what we consider to be our main function, and that is the training of undergraduates in both areas of the sciences to the best of our ability.

It is perhaps worthy of note that we consider our best contribution to Canada and to science in general is the production of a quite large proportion of well-trained candidates for the graduate schools. The number of pe-

ple in honours programs at Bishop's is relatively very high, and a great many of them go on to graduate schools all over the country. We think that if we are to maintain that kind of performance that we have managed to achieve in the past we have to involve ourselves in some kind of research program.

We need to do this specifically because we must attract staff. Many young men are determined to continue only at places where research facilities are available. So, we have started, and we intend to continue, a graduate program at the Master's level which will satisfy these needs.

I would ask the committee, sir, to remember that the problems of a university that is 1,000 strong, with a limited graduate effort, are not the same as the problems of a very large university with a very large graduate research effort. We think that these facts must be borne in mind in any science policy in Canada, and we are indeed in need of support for this kind of program. Naturally, we would not be in favour of any concentration on centres of excellence. We think that it is necessary to support research at places like Bishop's, and we think that some special arrangements will probably have to be made for institutions such as ourselves.

We think that the special advantages that we can offer have already been mentioned. The contact between the graduate student and his supervisor and the staff generally is very close, especially in the sciences. At Bishop's we like to think that the same contact is found in our undergraduate work. We feel that on a small campus and on a small scale we can continue that kind of contact both between the staff and the graduate student, and between the graduate student and the undergraduate student, and we think that this is a very good thing from the point of view of the training of prospective graduate students at some other university.

The problem, if I may repeat myself very briefly, is to get a place the size of Bishop's over this threshold. We are just about approaching the point where we can make a quite significant contribution, especially in the training aspects of any research program.

Thank you very much, Mr. Chairman.

The Chairman: Next we will hear from Dr. McDougall of Loyola College, Montreal.

Dr. D. J. McDougall, Chairman, Geotechnical Sciences Department, Loyola College, Montreal: Mr. Chairman, honourable senators,

ladies and gentlemen: much of Loyola's brief to this committee was covered in some of the remarks of the gentlemen from the Atlantic provinces yesterday. The principle problem we find in research at Loyola, which is comparatively small, with a fairly active research program amongst the professors on staff, is that we have no graduate students; we need to use research assistants if we can get and pay for them; we need to do this in order to attract staff and maintain a suitably high level of instruction for the students, because we are certain this has a large bearing on the excellence or lack of excellence of students who graduate from us.

The real problem is that of finding salaries for research assistants and research technicians. In general, the type of grants we have been able to get provide for this in part but not in whole, so we have to find other means of doing it. Some of this can be done through the college, but we are limited in what we can get from this type of source.

There has been expressed by people at the college and elsewhere the opinion, that can be taken for what it is worth, that a good research assistant is worth several graduate students. No doubt some of you will have encountered graduate students who are not very effective. For some of the better undergraduate students we have in geology, physics and chemistry a program whereby they are expected to do a certain amount of research. This is not too dissimilar from what I think those from St. Mary's were suggesting yesterday. However, even here there are problems, and it is no kind of replacement for graduate students; undergraduate students simply do not know enough at that stage; we find it takes them a year to find their feet, and by that time they really cannot get very much done.

Some professors undertake research on their own; some have utilized undergraduates during the summer; they have borrowed, in one fashion or another, graduate students from other universities for summer work. They have hired research assistants. We have one or two post-doctoral fellows. By and large we find that the trained research assistant is almost invaluable. In contrast, the temporary part-time student graduate or undergraduate is not so useful; by the time their training is finished they have to go back to school. That is one of the real problems.

Out of all this we have made some recommendations. First of all, consideration could be given by a granting organization such as

the National Research Council to individual requests to employ assistants. This poses a problem that was mentioned yesterday, that one cannot be sure of continuity; it is on a year to year basis, particularly if hiring a research assistant who is not a student, and cannot be expected to be treated as a student, who does not like being told, "I can hire you this year but I do not know what is going to happen next year."

A second possible recommendation would be to have consideration given to groups of researchers who have more or less common interests, whereby they would be able to employ technicians or assistants on a long-term, probably pooled, basis, something that could be shared. I understand that under the existing regulations for the NRC initiated development research this does not appear to be provided for. This concept of pooling assistants among people who are working in more or less the same area would lead into the idea of interdisciplinary studies and interdisciplinary institutes, which is something that I believe could be considered, particularly for smaller universities, or perhaps groups of smaller universities.

That again leads to a third possible way in which this might be handled, in the establishment of some sort of organization which would have as its objective a form of policy collaboration on research and the relationship between government and industrial laboratories. As you know from the hearing yesterday, the Atlantic provinces have been able to do this. I think we could have something like this on a possibly regional basis in Quebec.

I find myself at a disadvantage in addressing the committee because most of the points I would want to make were discussed yesterday. However, perhaps this serves to indicate how common they are.

The Chairman: It is a new aspect of Canadian unity!

Dr. McDougall: Various people in our college have done something along these organizational lines. They have made arrangements to use other laboratories, and there has been a certain amount of trading of information back and forth. However, this is always on an individual basis. I personally have found that I get remarkable cooperation in some areas and virtually none in others. I have been startled to discover some places where I get lack of cooperation, but this is not an Anglophobe or Francophobe relationship, because some French universities collaborate very

readily and sometimes it is the other way round. It therefore seems necessary to have some fairly formal arrangement established, perhaps on a federal basis or on a regional basis. I am not sure what the answer is.

That in essence is what I have to say. For the smaller undergraduate colleges and universities the problem seems to be closely allied to lack of sufficient help for (to use a phrase used in the report by the Canadian Association of Graduate Schools) the little research program.

The Chairman: I understand that Dr. Catherine Haggart Westbury, from Marianopolis College, is not here. So we will hear finally from Dr. Ufford, Assistant Dean of Science at Sir George Williams University. He will replace, this morning, Dr. Samuel Madras. Thank you.

Dr. J. R. Ufford, Assistant Dean of Science, Sir George Williams University, Montreal: Thank you, Mr. Chairman. I would like to take this opportunity to thank the committee for this chance to express some of our views and concerns. One of our big concerns at the moment is that the competition for funds to support research is constantly increasing, and we are afraid that there is a tremendous amount of unwary duplication in the efforts which have been carried out. We would like to see some sort of co-ordination between universities on research projects in order to prevent as much duplication as possible, but we would like to emphasize that in this co-ordination it should be set up in such a way that there is no block to the development of the newer universities.

A second area of concern for us is the current decreasing possibilities for employment of science students. One of our concerns is to try and find some way to develop employment opportunities for graduates of Canadian universities. We feel that if these can be developed we can keep students taking science courses in universities and therefore will not get into problems of decreasing numbers and rising costs. We should like to see a vigorous Government policy to encourage research by Canadian industries in Canada, again to support the employment of undergraduates. We should also like to see the universities turn more attention to applied research and not deal exclusively with what might be called pure research. We would support the suggestions of McGill, that support for research not be confined to one area but that the support be obtained from as

wide an area as possible. Also, we should like to support McGill's opposition to the Macdonald Report in regard to the support of graduate students from operating grants. Thank you, Mr. Chairman.

The Chairman: Now, I would propose that we should proceed first, during our discussion period, with the brief which was presented to us by the French-speaking universities and then deal later with the other English-speaking universities. I think it would be more convenient for the purpose of our discussion.

[Translation]

Senator Bourget?

Senator Bourget: Thank you, Mr. Chairman.

Dr. L'Abbé, you mention on the first page of your report that you wish to stress the need for close co-operation among the various representatives which you subsequently list. Could you tell us what kind of body you would suggest to establish closer co-operation among these representatives?

Dr. L'Abbé: The brief does not answer this question explicitly. It emphasizes the importance of co-ordination. On this subject, I can give you either my personal view or the view of the University of Montreal.

The Chairman: Am I right in understanding that you are not speaking in your role as general delegate at this point?

Senator Bourget: Are you giving us your personal ideas?

The Chairman: Since Dr. Kerwin is present, he can give us Laval's views.

Dr. L'Abbé: A suggestion on this subject was made to the Macdonald Commission by the University of Montreal when they met; it was made again in a recent brief to another body. This was the suggestion to set up a national committee which would not be federal only but rather a joint federal-provincial committee. Such a committee would thus include both the federal government and the provinces in its representations, because, in view of certain aspects of research, each province should actually establish a policy in this area. The federal government should also establish one, since there should be a policy for Canada as a whole, for the Canadian nation. I feel, then, that the various governments must work together and the idea that a federal-provincial committee could play such a role is one that has already been

expressed. This would make it possible to solve jointly the problems of disparity which I mentioned in the brief; it would make possible concerted action on important scientific developments which are now very expensive for a country and which must be carried out with a great deal of selection. These policies must be very specific, therefore, but they must at the same time be universal and involve everyone.

Thus I feel that the idea of a federal-provincial committee would make it possible to arrange this kind of co-ordination and overall planning more adequately.

The Chairman: Would this be an advisory committee?

Dr. L'Abbé: Yes, Mr. Chairman, but an advisory committee to the governments, and its recommendations might therefore have an influence on federal policy, and, to the extent that certain provinces are also involved, on the policy of these provinces.

Senator Bourget: In your opinion, Dr. L'Abbé, how should this committee be made up? Should there be representatives from the universities only or from each of the provinces only? If there were more representatives from the universities, this committee would be...

Dr. L'Abbé: I do not think that this is necessary. There are other ways of representing all the parties concerned numerically than through us. There is already a Council of Ministers of Education; surely this council could delegate people to represent it as a whole. There are certainly ways to avoid multiplication of this kind, which is ruinous and serves no useful purpose.

The Chairman: Dr. Kerwin, do you have any comments to make?

Dr. Larkin Kerwin, Vice-Rector (Research), Laval University, Quebec: Yes, Mr. Chairman. In reply to Senator Bourget's question, an effort must be made to avoid an organization for preparing the country's science policy, which is uniform and locking in diversity, since such a situation would be static. Research, on the other hand, is dynamic. Since research is dynamic, the structures needed will vary, sometimes from year to year, but particularly from one generation to the next. Thus we in Canada will not be inventing the organization to end all organization for science administration. Other countries before us have tried to do so. Many

experiments have been made in England, France and the United States, and inevitably several structures were established, because, for no matter what area a system is evolved, scientists are ready to invent another, either in competition or in answer to new needs. As a result, the committee suggested by Vice-Rector L'Abbé would be an excellent idea because it would answer a need which is not satisfied at the moment.

There are other necessities, however, and still others will appear a few years from now. For this reason, a flexible policy is needed. Above all, we must avoid trying to establish a structure which would include everyone and which would attempt to determine science policy once and for all, so to speak. That would not be a science policy at all—science is not like that.

The Chairman: I agree that federal-provincial-university machinery which would do nothing but talk and which could not reach any conclusions should be avoided.

Dr. Kerwin: Exactly. Scientists will find something to work on immediately.

Senator Bourget: Dr. L'Abbé, will this committee also concern itself with finances and financial aid to universities, or will it only be concerned with determining science policy?

Dr. L'Abbé: It will naturally be a political body with an essentially advisory role toward the government authorities; it will not itself, however, be involved in research or in distributing funds for research.

Senator Bourget: Following the order of your brief, I see on page 2 the statement that it is of prime importance that the authorities concerned agree to devote a greater part of the gross national product to research. In your opinion, how much of the gross national product should go for this purpose? Do you have any ideas on this subject?

The Chairman: Could you try to give an exact answer?

Dr. L'Abbé: Yes, we naturally considered including figures, but after consultation we decided that, in view of the urgency of submitting our brief, we would not have the time to do so. Basically, we suggested as a goal to reach in five years' time the ceiling of 4 per cent which has presently been reached in the United States. This may seem unrealistic to some people, but...

Senator Bourget: For the next few years, in particular?

Dr. L'Abbé: Yes, perhaps we should say over the next ten years. It seems likely that other countries may have gone well over this ceiling by that time. Perhaps my colleagues Dr. Kerwin has some clearer ideas on this matter. We had planned to be more exact in this regard and we consulted with one another, but we found that we were at a loss for a decision.

The Chairman: Do you have anything to add, Dr. Kerwin?

Dr. Kerwin: Mr. Chairman, we see no reason why the various calculations worked out by several committees and research bodies should not be referred to. The figure generally given for Canada's expenditures on research and development is in the area of 1 per cent; it varies between 1.2 and 1.5 per cent—agreement must be reached on what that means, but in general these are the limits. Similar studies indicate that in the United States and England—and somewhat less in France and West Germany—the figure varies between 2.8 and 4 per cent. Even though we may debate the fraction, the factor 2 remains. The factor 2 would be an excellent goal to set to be reached in five, or, if we are pessimistic, in ten years' time. However, as long as this factor 2 is not met, I feel that scientists would be well advised to quote Samuel Comber and say that they need "more".

Senator Bourget: You also say, on page 3, that Canadian science policy should be pluralistic. Do you mean by that that there should be no overall policy for Canada or possibly that the Canadian government's policy should take into account regions and provinces? Could you explain what was meant by this statement?

The Chairman: Or perhaps various research centres or sectors were meant, or else government, university or industrial establishments?

Senator Bourget: That is right.

Dr. L'Abbé: Yes. Of course, it is both an important and a difficult question. It is perfectly obvious that we do not mean that an overall policy is possible. On the contrary, we hope that there will be an overall policy, but such a policy must take into account this very pluralism. It must not block either regional differences or our attitude on cultural differ-

ences, which perhaps do not have repercussions on science itself, since science is universal, but which do have obvious repercussions on research workers and scientists. This means that in a way the sectors of scientific activity could be distributed. There is no need for everything to be repeated in the various regions, which would be ruinous, or in the various Canadian communities, which would be just as ruinous, when there is no justification for such action. Such great efforts may be made that it will be enough to have one centre in Canada, but it must be an excellent one. There is a whole system of complementarity to be established, but I shall venture to limit myself to the part which concerns cultural differences and the French and English-speaking communities. A little more than the pooling of efforts is involved here. To take a concrete example, it makes little difference to the people of the Maritimes whether meteorology is taught as it is at the present time in Toronto, McGill or Vancouver, because, in any case, there are excellent centres in these places. These are English-speaking centres, and a Maritimer can go there and feel at home. It is, however, quite standard that there are no French-speaking meteorological centres financed by the federal government in Canada. Establishments of this kind should be multiplied until there is an adequate number to serve both communities, since here it is a question of research leading to the training of research workers.

In other areas, the problem of communications, the vast field of communications will also have aspects which will inevitably bring in this cultural factor. This cultural factor, however, is far less important in other areas and may be completely ignored; it is possible to imagine a French-speaking centre which would be excellent for Canada as a whole or again an English-speaking one which would be excellent for the entire country, and such a situation, in fact, would be very desirable in certain sectors where a real joint effort would be made to establish international centres of some value.

Senator Bourget: Then, that is actually related to the proficiency centres which you mentioned in your brief and which, in your opinion, would be the proficiency centres which we could have in Quebec because there is some talk of distributing those proficiency centres in different regions. In view of the history of our universities, of which Dr. Dugal's minority report made mention, there

would perhaps be a need to divide up the proficiency centres. Now, in your opinion, what proficiency centres could we set up in Quebec?

Dr. L'Abbé: Hold on. You are asking a rather difficult question. Do you realize that such an answer requires a...

The Chairman: Yes, whether it will go to Montreal, Sherbrooke or Laval certainly will not be decided this morning.

Dr. L'Abbé: No, even that we...

Senator Bourget: I did not specify Montreal, Quebec or Sherbrooke. I am speaking from a provincial point of view.

Dr. L'Abbé: Yes, you are asking me a question which will bring in all the political arrangements at the science level, the Canadian level and the provincial level. I would hesitate to make any specific suggestions although there are some.

The Chairman: No, but let us say in Montreal for example. What areas in your university at present seem to be at a first-class level with respect to others?

Dr. L'Abbé: Well, listen here...

The Chairman: That again, it is...

Senator Bourget: In Quebec, for example from a language point of view?

Dr. L'Abbé: If you will allow me I was just about to do so and I am going to let Mr. Kerwin answer. However, I could talk because we are somewhat ahead in mathematics. That is perhaps tooting my own horn to some extent considering that I have returned to the same subject but it is the area I know best. There is already a national mathematics centre planned, which will begin this fall, financed by the federal government and which will be extremely important. It seems to me that there is another area which would be well adapted to the Montreal region. It is that of urban studies. Montreal is a vast, natural laboratory for everything concerning urban problems.

The Chairman: It would be developed around the urban planning department, I suppose?

Dr. L'Abbé: Of course. We already have a highly developed urban planning department, an urban studies section which is rapidly

growing. There is much interest in the Montreal region. Obviously, there are other universities which can take part in it. It seems to me that, urban research and even regional research to some extent as urban regional planning could be an excellent area for Montreal.

The Chairman: Is Dr. Selye's institute independent but affiliated with Montreal?

Dr. L'Abbé: No, it is not independent. It is part of the faculty of medicine but that is a rather special case which involves an area which had—let us say that I refrain from discussing that question. Obviously, it is the whole area of health. The organization of duties is extremely involved. However, there are other areas in which we are somewhat advanced for the Province of Quebec i.e. another area is that of fresh water. Quebec is a natural reservoir of fresh water. Canada in general and Quebec in particular in that regard have rather extraordinary resources for all the American continent. Therefore, it would not be unusual for a water institute, and a fresh water institute in particular, in Quebec to attain a truly international scale. The same thing applies to applied research for hydroelectric power. However that has already begun thanks to Hydro-Quebec.

Senator Bourget: Thanks to Hydro-Quebec?

Dr. L'Abbé: Yes, and whom we hope will develop even more because of funds made available not only by the provincial but also by the federal government.

The Chairman: And, obviously with the co-operation of atomic energy.

Dr. L'Abbé: Yes, that is right.

Dr. Kerwin: Mr. Chairman, a few moments ago, I was going to be much less shy than Dr. L'Abbé and tell you that the mathematics centre at the University of Montreal is an excellent example of an area which could become a truly international proficiency centre for Canada. In mentioning water research, Professor L'Abbé also touched on an area where Quebec is highly competent. We have the resources and this is an area of major importance for Canada. I shall mention two others. Even if there are other centres in the country, it is essential for the whole of Canada that, in Quebec, research on the Far North be carried on and developed for there is also fine competence in that field.

Finally, it seems to me that Quebec clearly stands out as one of the important research centres on bilingualism and biculturalism and that applies also on the international scale. We know that there are perhaps twelve large-scale centres in the world. There is no reason why Canada should not rank with them one day.

If you will allow me Mr. Chairman, I should like to complete Vice-Rector L'Abbé's idea with an example in order to answer Senator Bourget's specific question about the pluralistic policy for science which will take cultural differences into account. Here is a specific example. Science policy is seen through a multitude of applications and among other things, a system for staffing laboratories has developed in Canada. This system enables us to employ professors, graduate students, post-doctoral scholarship students, research assistants, and so on to form a hierarchy. The system was conceived to meet the needs of laboratories faced with the labour market. However, that market is the North American one and recruitment possibilities are here and there and are reflected in that policy of establishing positions. However our situation in French Canada is very different. We do not have the same recruitment possibilities at all and our recruitment problems are much different from those of English-speaking universities. Consequently, that cultural difference which makes itself known by a recruitment problem must be reflected in science policy by the creation of appropriate frameworks for such a situation. That is a specific example where science policy must demonstrate itself through two forms of structure of policy which take into account the needs and the cultural situation of the two language groups.

Senator Bourget: Is one of the reasons which makes your recruitment a problem due to the fact that you do not have sufficient financial resources or is due to the fact that it is difficult for you to find the competent researchers you need?

The Chairman: Or are needs increasing too quickly?

Dr. Kerwin: No, it is our geographical situation. To repeat the phrase mentioned on countless occasions, we are 6 million people submerged in the ocean of North America. It is not unusual for the English-speaking universities to recruit a good part of their staff abroad. It is good and it is desirable. It is

also good and desirable that we should be able to do the same thing. However, we cannot turn to our neighbours. We must go further. We must recruit on a world-wide scale. Therefore, that must be brought out in the structures and in the patterns.

Senator Bourget: Well then, with the new exchanges especially between France and Quebec, would there not be some way of recruiting the researchers you need in the French-speaking centres?

Dr. Kerwin: Yes, the system which was recently implemented by the National Research Council, on the one hand, and by the National Arts Council on the other, is precisely a partial answer to a policy which will take cultural differences into account. Our brief maintains that the policy must always be before us when elaborating the standards.

Senator Bourget: Then, what would be the suggestions you would have to make?

Dr. Kerwin: Well first of all, I am perhaps anticipating your questions, Senator...

Senator Bourget: Go on.

Dr. Kerwin: I apologize because it crops up later in the brief. In Canada, we have approximately thirty large-scale federal laboratories. Those laboratories are scattered here and there and are fortresses of strength for both the recruiting and the marketing of scientists. However, only one of the thirty laboratories is somewhat bilingual. That is the Defence Research Board laboratory in Valcartier. And so, just as it is not unusual to have dozens of these laboratories...

The Chairman: Is there not a laboratory at Laval?

Senator Bourget: Yes, it is on the Quebec campus.

Dr. Kerwin: I am sorry. You are perfectly right. There is a small laboratory there also.

The Chairman: We went to Laval too, you know.

Dr. Kerwin: You are quite right. There is that one.

The Chairman: And, in agriculture?

Dr. Kerwin: We have hopes.

Senator Robichaud: Were approaches not also made by certain federal departments to Quebec authorities to set up laboratories in co-operation with Laval University for example and was that co-operation granted?

Dr. Kerwin: In what way, for example?

Senator Robichaud: Fisheries for example.

The Chairman: Fisheries—Senator Robichaud is the former Minister of Fisheries.

Dr. Kerwin: I know that there is our biology department which wants to set up its marine biology research centre and is waiting patiently for the conclusion of the agreements.

Senator Robichaud: Perhaps the federal government is also waiting.

Dr. Kerwin: Then the waiting will end tomorrow morning.

Senator Bourget: Dr. L'Abbé, to continue with that line of questioning, were specific requests made by the universities to set up laboratories, were they turned down and what reasons were given for refusing the establishment of certain laboratories requested?

Dr. L'Abbé: Yes, I do not think that is quite how the laboratories were set up. At present, we are talking about federal laboratories. It is truly the federal government that takes the initiative in setting up and centralizing its own laboratories.

The example is extremely important and I want to underline Mr. Kerwin's comment that the scientific potential of the country is not monopolized solely by the universities but by all employers of scientists. At present, federal laboratories are one of the largest employers and are also a reservoir of scientists who, afterwards can come to the universities that want to hire university graduates.

I wish to point out the existence of post-doctoral scholarships awarded to foreigners, as such non-Canadians, to come to Canada. They have been in existence for a long time. Previously, there were approximately 175 scholarships awarded each year. Approximately fifty of these went to universities and of those fifty, approximately eight went to French-speaking universities. The post-doctoral scholarships were eliminated at the university level and only the others were continued. The others were for English-speaking federal enterprises, thus enabling Anglo Sax-

ons, persons already speaking English and bilingual persons to come to Canada and very often to remain here and to add to the potential of Canadian researchers. However, in that regard we, French-Canadians, were at a great disadvantage because the welcoming environment required, as it were, an Anglo Saxon network to supply it. It is impossible to imagine a French-speaking person arriving at the National Research Council and not speaking English and even in my opinion, at Valcartier where administration is still unilingual. Valcartier is beginning to become bilingual but there is some talk now about making it into a unilingual centre which would be normal in order to compensate the Anglo Saxon unilingual centres which exist and which will not change. However, at the present time and in the past, even rather recently, those possibilities did not exist. It is not a question of university action but of federal government action because it is its own laboratories, answering either to departments or to important Crown agencies, which have that responsibility.

With regard to the research centres which would be proposed by the universities to the federal government, we are presently working together to meet such requests and I am rather optimistic about future results. The mathematics centres is already an example. That of CRAM at Laval is another.

I was talking about urban and regional studies. At present, we have already taken steps to benefit that type of institution.

At the end of our brief, when we mention unilingual federal laboratories in Quebec, we also added the existence of proficiency centres which would be set up either at a Quebec university or in co-operation with several universities and the federal government. Therefore, that is a case of joint bodies, as already exist in the Anglo Saxon field in some places.

The Chairman: As suggested earlier by Senator Bourget, there has not been much pressure, until now and as far as I know, upon the Federal organizations by the French-speaking universities, to do in Québec what has been done elsewhere, and I really have the impression that other universities are relatively often in Ottawa to present their claims, or to exert pressure.

Dr. L'Abbé: That is undoubtedly correct, but this also reflects in a certain sense, the aspect which I mentioned, to the effect that

the Federal organizations are largely under the control of the English community; this is not a reproach, but a reality; it is a fact, and knowledge of future policies concerning possible resources makes the discussions easier; we have not formed a part of the normal network which exists everywhere, so to speak; but we are getting in there, and I think that things are beginning to change.

The Chairman: I believe that even in the past, just recently, it was very difficult for certain Federal research organizations, who also had the function of distributing subsidies, etc.,—it was rather difficult for certain of these organizations, to recruit French-speaking Canadians, because, apparently, they were rareties; I do not know, but...

Dr. L'Abbé: That is entirely correct. I must now say, that we are finding, the three universities combined, in the various fields, the complementation, the necessary resources to exactly find there the candidates that are as qualified as the others, and...

Senator Bourget: It will probably be easier in the future, due to the degree of excellence which you are now achieving, as mentioned in your report. There will, undoubtedly, be some slight difficulties, but I believe that you will be able to overcome them.

Dr. L'Abbé: Yes, but they will probably not be overcome by the simple course of events; corrections will have to be made to establish a certain discontinuity and to guide the future in a different manner. This has already been done, I might say, in certain organizations. For instance, the Canada Council, in my opinion, admirably reflects the bi-national character; it is the only organization, in my opinion, where one can express himself in French and in English, and be understood.

The Chairman: Does this not mean, exactly, that the persons we have trained,—I do not want to speak for my constituency,—but, that the persons we have trained in our Social Sciences Faculty, were more active on the Federal level, as compared to the sciences,—the natural sciences, or the human sciences?

Dr. L'Abbé: I have just a short remark to make on that subject; when the humanities are involved, it is obviously more normal that bilingualism is expanded with respect to sciences, because we clearly know that in physics, for instance, English is the language, and that in the scientific field, this is a real-

ity—whereas, in the humanities and also in the social sciences—the requirements are different. But, as you said, it is quite possible also, that particularly the role of Laval has been important from that point of view, and has favored this type; but, naturally, when you are in political sciences, you are mixed up more with politics than when you are a chemist, or a geneticist.

The Chairman: But, is the mentality in the science faculty not in the process of being changed, so that, today, the scientist will have to participate in shaping the scientific policy, because otherwise...

Dr. L'Abbé: Judging by those who are presently occupying themselves in the universities with questions of research, etc., there is quite a change, and our corps of professors also has become much more representative of the various tendencies, from that point of view; it has been enriched by a foreign influence, an international influence, which we have assimilated and they now can easily serve at a level that is certainly international, and, therefore, also national.

Dr. Kerwin: Mr. Chairman, I should like to make three points, if you please. I respectfully submit that I fail to see that a question of mentality is involved, when you make a distinction between the effects upon the social sciences and natural sciences. The social sciences, in general, are a recent phenomena in Canada, and the French speaking universities have achieved a certain maturity, at the same time as the other universities in Canada in this field. Therefore, I would say that they entered the field in plenty of time.

The Chairman: I do not believe that that is true.

Dr. Kerwin: Whereas, in the natural centers, we are quite young; we do not have French Canadian physicians who have died, or who are grandfathers.

The Chairman: The department of economic sciences was founded at Queen's in 1899, and the first economic department founded in Quebec was in 1943.

Dr. Kerwin: It is obviously worse for the natural sciences, because I observe, as far as I am concerned, that scientists are present in Ottawa, and on the committees, and for a long time, but always in proportion to their number, meaning, 10 per cent, and I do not believe that we should dwell on the reasons,

or the blame for that, but that we should observe the facts and should look for remedies.

Thus, earlier, to return to my other point, we did not reach the logical conclusion of the discussion, which involved that question of the Federal government's laboratories established in the Nation. If these 30 English speaking laboratories exist, it is a very precious reservoir for the English speaking universities and for recruiting and for showing off their degrees.

Therefore, in order to have an analogous situation, in order that we may have those possibilities for hiring and showing off our personnel, there should be more French speaking persons, or bilingual persons, scattered equally over the Nation, not necessarily in Quebec, but probably in the area of Winnipeg and in the Moncton region.

Consequently, a scientific policy that takes these cultural disparities into account,—that is another special point that has been raised further in our brief.

So, to come to my third point, Senator Bourget touched on what is for me the essential point of our brief. This is that 30 years ago, it would not have yielded results if they had invested millions for research in our French speaking universities, as it is considered today; we did not have the professors nor the personnel; it had to grow, like the others, and now, we allege that we are ready; we have three universities of stature, with an excellent staff, several of whom have international reputations, and we are now able to play the role that has been played by others for a couple of generations. A couple of generations ago, the circumstances were such that institutions such as Toronto, or McGill, could serve as centers of excellence for Canada and, thank God, we had McGill in Québec, and Toronto in the English speaking part of Canada; that is what gave us an international reputation and that is also where much of our management was trained. Well, we now have to relive that experience. We could not have gone through that experience in French Canada a generation ago, because we were not ready, but now, we are ready, and there is a resource, a natural wealth, which Canada must now exploit, as it has known how to exploit it two generations ago.

Senator Bourget: I am with you for one hundred per cent.

Dr. L'Abbé: This is an official question and I truly believe that the essential part of our

brief is this, what we find on page 11, which is the end, and which may be the most dynamic and perspective point of our brief, I believe.

Senator Bourget: Yes, you also speak in your brief, Dr. L'Abbé, of close relations, of communications that must exist between the universities and the various agencies of the government; what kind of a mechanism are you providing in order that there may be closer ties between the universities and the various agencies, because it seems that in certain agencies French speaking Canadians are absent. So, would you have a few suggestions in order that our presence be better felt and our needs be better understood?

Dr. L'Abbé: Yes. There certainly are recommendations that can be made for that type of an idea. There is already a committee that was established jointly by the Research Council for Defence and by the National Research Council to study these questions, especially questions of bilingualism and biculturalism as a function of their mission in the two organizations and the universities. That committee, which started to function a short time ago, will submit a report to each of the two councils of those organizations in that respect. It obviously goes without saying that the normal thing is to be represented by qualified persons in these organizations in the same manner as are our English speaking colleagues. But, there again, it seems that, maybe during a transitional period we have to add more, in order to correct the situation. I told you, those organizations will remain unilingual for a relatively long time to come. It is out of the question to go to the Research Council for Defence, of which I am a member, and to speak French. I think you could do it, but we would be understood by a few French speaking Canadians and maybe one or two English speaking members.

Senator Bourget: Do you have simultaneous translation during your meetings?

Dr. L'Abbé: No, no. I believe that the National Research Council works in that direction. It is a palliative. But it is not, in my opinion, sufficient. It would therefore, be necessary that there are, in addition to those groupings, means of a temporary nature, that would operate let us say for a period of 4 or 5 years, and that would commit to committees that operate purely in French, like others operate exclusively in English, in order that—it may look superficial, does it not, to

be able to express oneself in his own language when things are involved that, from all appearance, are quite international in nature, but I think we are making illusions. If you want to express yourself in your own language, you know the types of innuendos you can use, you can understand half a word, you are able, in some sort, to capitalize on the whole culture for which the language is the vehicle. This applies to sciences as it does to other fields.

Senator Bourget: As in politics.

Dr. L'Abbé: As in politics, undoubtedly.

Senator Bourget: We have had that experience. Only, we realize nevertheless, that we must correct the situation, and that is the reason why I am asking you.

Dr. L'Abbé: Yes, it is somewhat to make things sensible and to correct them somewhat, and, therefore, these are not recommendations that would set up permanent separate organizations, but that would provide for a certain period of time, the mechanism to correct that situation. Those things are somewhat improvised, but I wished that there were committees, as there is one on organizations procedure, that stoops and studies, and that makes concrete recommendations of that nature.

Senator Bourget: Mr. Chairman, I would have other questions to ask, maybe, even now, but I see that it is twenty minutes to twelve.

The Chairman: Do you have anything else to add, Dr. Kerwin?

Dr. Kerwin: No, Mr. Chairman.

The Chairman: I think, then, that you will nevertheless be able to participate, now that you have spoken to us, the language of confidence, as was said by René Lévesque.

Senator Bourget: Would there be a chance that we come back, Mr. Chairman, because there are still other questions.

The Chairman: Certainly. At any rate, I think that this discussion is ending provisionally on a very optimistic note, in the sense that I have the impression that, from now on, there will be a greater positive participation on the part of the French speaking universities in Quebec in the scientific efforts of the whole of Canada.

[Text]

Senator Cameron, do you have some questions to ask either of the English-speaking or the French-speaking universities? You can ask your questions, and I am sure they will be answered.

Senator Cameron: There is one problem that has been bothering me for some time. How do we deal with the situation of these small universities such as Bishop's and some of the others? On the one hand, we are saying we must have centres of excellence but, in effect we have big establishments with resources in depth of a large number of researchers, and I think we must have that, but this will never be possible in the small universities. So, what is going to be the role of the small university which, from a purely academic standpoint in the fields of mathematics, history, literature, and so on, may do a better job than the big universities? What is their future in the research picture? I would like a little more elaboration on that, and as to how they can get a proportion of the research funds and as to what they can do with what will always be limited resources.

Dr. McDougall: I think I can say something on that, Mr. Chairman, and this is a personal opinion. I do not think that a centre of excellence necessarily connotes science.

Senator Cameron: No, that is true.

Dr. McDougall: I do not think that the small universities, in engaging in selected areas of research, are necessarily going to rock the boat. We can probably individually and as a group work very well in more restricted areas—perhaps in some area of research for which there is not a large amount of funding—and do an excellent job, and even a superior job because they are working with more detail than can be expected from a larger group in respect of which this particular area is only a small aspect of what it is doing.

Dr. Frost: Could I try to answer that question? I would suggest that there is no black and white answer to this. Small university centres, if they have enough workers, may very well do excellent work, but their efforts are going to be tempered by lack of facilities in all the departments. What we at McGill would like to suggest is that the larger university become a kind of umbrella institution for graduate studies and research, so that people who are teaching at the undergraduate

level in the small university can, in certain geographical circumstances, be linked with the larger university for their graduate teaching and their research. We at McGill would welcome this kind of co-operation. This is not always possible for geographic reasons. I think a very good case could be made out for Sherbrooke to develop on its own simply because of geography, but in the case of the Montreal institutions I for one—and I know this is the thinking of my faculty—would welcome the opportunity of having our facilities made available to people other than those on the McGill staff.

[Translation]

Dr. L'Abbé: I should like to make one or two remarks on that subject. Mr. Frost has mentioned Sherbrooke in particular, which has started to solve that problem in a manner that, in my opinion, is excellent, by specializing itself in some sort in certain fields and I would like to remark that, presently, the field of medicine seems to be becoming something remarkable, by the introduction of a somewhat revolutionary curriculum and methods, which is even being watched outside our borders, whereas this seemed difficult in our own universities that are somewhat mired in certain attitudes. We have there an example of a regional university, not too well developed, but which strives for excellence in certain fields which it has chosen deliberately and in which it is able to operate in an excellent manner.

Another remark, relevant it seems to me, which could help greatly the universities, the small universities in a centre such as Montreal, which perhaps would not be the solution mentioned by Mr. Frost, to put some of the resources of the large universities at their disposal, is to make some of these resources, in my opinion, communal, so to speak, and nearly decentralize them. And, I am thinking of three orders of resources, libraries. A city like Montreal, I think, should eventually have a single university library, a large library which will be the meeting and working place of all the researchers in the area. These libraries, I believe, should not be the property of any university in particular. They should be a community affair. I do not see any objection to the same being done for what is called the "computing" resources. There again, a researcher in a university, a small university, can be disadvantaged if he does not have access, and every day, or at least in a very direct fashion, to these resources. There is also, because of the volume and of the danger of multiplying very costly re-

sources, the fact that it might be advantageous to have a consortium where these resources would really be pooled. They would not be under the management of any university in particular. A last field of this kind, a last kind of resource which is important to social sciences, for the same reason, is what can be called the data banks which are also subject to large investments and could be the subject of a common consortium.

The Chairman: Dr. Kerwin.

Dr. Kerwin: Senator Cameron, allow me to offer a suggestion to solve the difficulty you have brought up. It happens that, if the small university can have, for instance, on the campus an excellent man, then his presence makes all the difference; and an excellent man knows how to do a lot of good things with poor means. I know because I was educated myself in a small university where there was an excellent man; he is sitting at the rear of the room at this moment. But the problem is that, in general, small universities do not know how to draw such people. Therefore, if the federal government could establish, in each university, a chair of top quality research, with enough remuneration to draw an excellent man, the effect on the small universities would be much greater than on large ones. This is a micro-element to the solution of our problem.

[Text]

Dr. Frost: That would make for other problems too, because we would have professors (federal) as opposed to professors (provincial).

Dr. Kerwin: J'ai bien dit «chaire de recherche».

Senator Cameron: I hope the members of the panel will not misunderstand me. I believe that the small university has a great role to play. Institutions in the United States like Antioch College, and Mills College in California, are doing very good jobs in limited fields, and I think that encouragement must be given to this kind of university in Canada, of which we have a number.

I think it is obvious that in terms of national policy these small universities will have to be told by whatever national body we have; "This restricted area of competence is the only area in which you can develop and get national funds." I would think too that these small universities can do their best work in the areas of the humanities rather than in the big scientific fields.

There is no question but that when a student in the biological sciences and the physical sciences wants to take advanced work in his discipline, he wants to go to a place where there is not just one man. He wants a program in depth, where he has the challenge of many minds. This is really the thing that bothers me so far as the small university is concerned. Certainly, they can have a great man, the ideal teacher—and it is a gift beyond price to have a man like that—but they cannot have very many of them in a small university. In my opinion this is going to pose a real problem in terms of working out a national policy. There is the problem of how we can make it possible for the small university to make its most effective contribution. The suggestion has been made by Dr. Frost that those who live within the periphery of a large metropolitan centre like Montreal can come under one umbrella. They can use the same library resources. This again is a matter to which the committee will have to direct some attention in terms of national policy, because as it is we cannot afford library services without proliferating; we must concentrate on that.

When we consider the area of the computer, obviously the cost of this kind of equipment and its utilization is beyond the resources of the small university, but it could be tied in under the umbrella of a metropolitan centre, just as we can with library services. I wonder how far the new technique of retrieval services can be extended to the small universities. Sherbrooke is not very far away, but what use can it make of the retrieval services? The same applies to similar universities remote from the larger centres. Certainly there could be a computer link, but I am wondering whether this would meet the need of the small university. This again is something to which we have to direct our attention. How do we do it?

Dr. McDougall: In the Montreal area, in some ways I think many of these things are actually being done on a quite informal basis. There is a small computer that is now linked to Ottawa, but prior to that we had one at Sir George Williams and also at McGill. There is a good deal of library interchange.

If I may revert to what Dean Frost said, at one stage, at the level of several departments, we tried to make an informal arrangement with McGill to borrow graduate students to work in something like the manner Dean Frost was referring to, but it did not work, possibly because it was the wrong time or the

wrong place. This is something I would like to explore myself on a personal basis.

The Chairman: Why did it not work?

Dr. McDougall: One of the excuses was that there were not enough graduate students to go round. In a few instances we suggested to some people that perhaps a graduate student could make use of our facilities; we did get one acceptance of this offer, which unfortunately turned out to be one we could not handle.

Dr. Frost: There is a very great deal of cooperation between Loyola and McGill in African studies.

Dr. McDougall: Oh yes.

Dr. Frost: And in French-Canadian studies with Sir George. The libraries are now in fairly common use. There is a great deal of work going on in history. As my colleague says, these arrangements are largely informal, but they are very active and very useful.

Dr. McDougall: There is activity in these areas. However, the area in which I would like to see more activity is that of the sciences—geology, physics, chemistry or biology—in which there could be some “backing and forthing” between the institutions, with more use of the facilities and more use of graduate student, whom we do not have and encounter a great deal of difficulty in getting somebody to replace.

Professor Dutton: It is true that in a small university research programs must of necessity be limited. However, this in itself is rather a contradiction in terms. The advantage of the small place is that it is not too highly specialized, not too limited; those who go to such a university do not talk merely to people in the department of physics but talk to others as well. It seems to be a contradiction to suggest that there should be an extreme limitation on the kind of research activities. Obviously we have to restrict them in some way, but if we can restrict them generally it would be much better than limiting them to one particular type. There are programs that can be followed in small universities, though they have to be chosen very carefully.

Senator Cameron: I meant restriction in the sense that you could not have a large research program in mathematics, another in physics and another in biology; you have to be selective.

Professor Dutton: Yes, I think so. Perhaps we have to pick an area in which we could use a mathematician, a physicist, a chemist or a biologist.

Senator Cameron: Dr. McDougall suggested the pooling of research facilities and assistants among the small universities. I can understand how this can be done under the large metropolitan umbrella, but is there much of a problem in McGill or the University of Montreal assigning a certain number of research assistants to, say, Loyola or Sir George Williams?

Dr. McDougall: This is precisely the problem I was mentioning. It has proved difficult to try to arrange some such system as this. In individual cases, very much on a personal basis, it has been possible, but not with any kind of regularized, systematized set-up. I was speaking specifically of pooling resources within a small university whereby there could be a sort of interdisciplinary organization, which would perhaps do a little more towards the research need. At the present time we have technicians for the services of the faculty of science, but their use for research purposes is necessarily somewhat restricted because they have other jobs to do as well. It would help if we could be sure of continuity so that we could hire people whose job was principally concerned with research projects, so that we could have one or more electronics men who could maintain equipment, possibly where we have a small research project in which a full-time research assistant was not necessary, a man who could work on one or two projects, perhaps one in physics and one in chemistry. This has reference to the idea of an interdisciplinary study organization that might be set up in this fashion, so that there could be an interdisciplinary research institute, possibly a materials science institute, as one finds in some of the comparatively small American universities, where there are people in physics, geology, metallurgy, sometimes biology and chemistry, working more or less under the same roof, using more or less the same equipment, utilizing the same processes and working on a series of studies.

Senator Haig: Pollution would be a good example.

Dr. McDougall: Pollution would be a good example.

Senator Haig: There are many disciplines affecting that problem.

Dr. McDougall: Pollution, oceanography. I would think materials science would be one area for an interdisciplinary group. Chemists could study polymers, metallurgists interests would be in metals, biologists in minerals and crystals, physicists in physical chemistry and so on.

Senator Haig: Would that be a fair example of use for the Montreal area, for a joint, cooperative, coordinated effort between large and small universities?

Dr. McDougall: It might work out.

The Chairman: You mean pollution now?

Senator Haig: Yes.

The Chairman: Not oceanography?

Senator Haig: No, no.

Dr. Frost: We already have a joint university of Montreal-McGill committee on pollution, which has been quite active for some time.

Senator Cameron: Again, in the case of the small university, is there any possibility of a sort of joint utilization of graduate students between the small university and industry, where you have enough work or facilities to employ graduate students full-time? Is there any possibility—perhaps it has been done—to have that person work part-time in the university and part-time in an adjacent industry.

Dr. McDougall: At the present time this is being done in the Chemistry Department at Loyola. There is a man doing research on organic compounds. He spent the last two summers doing research at Loyola and the winters working in industry.

Senator Cameron: I want to come to Dr. Ufford's statement about duplication of resources and the need for some agency to direct and co-ordinate the utilization of funds in university. I would like some further comment about this.

Dr. Ufford: I do not say there is any conscious duplication. Any duplication is surely an unconscious thing and becomes apparent sometimes when it is too late to do anything about it. If there was some way of co-ordinating research projects on a wide scale—it can

be done very easily on a narrow scale. For example, in regard to the chemistry departments at Sir George and McGill we know what is going on in both cases and have little, if any, duplication. We do not know what is going on in detail at U.B.C. or Alberta. We have a general idea, but the details are not known. If these details were co-ordinated in some place, I am sure there could be a cut-down on any possibility of duplication before anything really starts.

Senator Cameron: Does this suggest to you a possible need for a sort of a national inventory of research projects?

Dr. Ufford: I would say so, sir.

Senator Cameron: Do you think it is feasible to have such a national inventory? Some people have said to me that it is not.

Dr. Ufford: I think it is, because it is done in Quebec at the moment. Laval keeps a running inventory of all research projects.

Senator Cameron: In both English and French universities?

Dr. Ufford: Yes.

Senator Cameron: I am very glad to hear it.

Dr. Frost: I might say it is a very large document. If we were to have a national one it would be an immensely huge document.

Senator Cameron: When thinking about using computers for retrieval techniques, while we do not want to restrict regional work it is quite possible that several people work on the same idea without any collusion or collaboration. I am thinking in terms of utilization of resources of money, time and plans. We must find some means of having an overall picture of what is going on so that we do not have this duplication.

I think the committee would be anxious to find out what would be the most practical way of doing this. Can we make a recommendation? What are our recommendations? Can it be that some attempt must be made to establish a national inventory of research projects in Canada? This even has implications beyond Canada, because there is not too much value in duplicating something done in the United States, France or Belgium. I realize it is a big job. Is there a practical way of getting this information pooled some way?

The Chairman: Perhaps Dr. Kerwin would tell us, briefly, how their system functions in Quebec?

[Translation]

Dr. Kerwin: The system to which you referred has just been started, Senator, and, up to now, I would not dare to say that it has been very useful. It consists, in short, of a complete list, with cross-references, of the theses which are directed by the professors of the six universities.

Well, to find oneself in there is not very easy. I believe that the main usefulness of the system, so far, has been to initiate this co-operation, to set up the personnel necessary to carry out the system, and we hope that our second try will be much more useful.

Personally, I am not very optimistic about the utility of detailed inventory of the research subjects across Canada. It is an inventory which loses its interest after maybe two months, because these projects are very dynamic and change very rapidly.

It would be advisable, no doubt, to make a limited inventory to know the fields that are being tackled, and the centres where this work is being carried out must be known.

What, I think, would be much more useful would be a policy of much higher travelling expenses to allow scientists and humanists, and especially their graduate students, to attend much more often periodical meetings, seminars and congresses, so that they can meet each other, because it is by visiting the laboratory or the shop in the college of the other university that we learn much more quickly and much more efficiently what is being done, when we compare this process to the use of an inventory.

I do not know of any inventory, neither at the International Council of Scientific Unions, nor at the Scientific Unions, nor at UNESCO, which was as useful as expected, and I believe that, unless remarkable progress is made in the treatment of information, within five years, that we should maybe rely more on visits,—and as Canada is a country 4,000 miles long and 100 miles wide, this creates special circulation problems, and I think that our science policy must take it into account.

[Text]

Dr. Frost: I am tempted to add that no decent faculty which graduates students has anything less than 10 per cent airborne at any one time. This business of being able to get to scientific meetings and to meet other people in the field is really more important than

having an elaborate print-out of projects. We, at McGill, have issued an index of research which indicates the areas of interest of the different professors. We believe this is another way of tackling this problem. It is an immensely important problem, and I would like to support the suggestion that funds to travel to scientific meetings is an important help in this way.

Senator Cameron: As a university administrator I am appalled at the escalation of travel costs, as it is. What you are suggesting may be perfectly correct, because I believe there is no better way than first-hand contact. However, this is going to call for a tremendous escalation of travel expenditures. In your judgment, is that the most effective way of getting this over-view we need of a national program of research?

Dr. Frost: I would say that of all the ways in which we might get this the most effective way would be through meetings of the learned societies and the various disciplines. I would really like my colleague who is here with me today and who is Vice Dean of Sciences to answer that, sir.

Dr. R. E. Bell, Vice-Dean, Faculty of Arts and Science, McGill University, Montreal: The difficulty with the big list is that it is too big for any one individual and therefore it is not suitable for anybody's use as an individual. Each person has a personal area of interest and the difficulty is to make him acquainted with the situation in that area of interest and as his job changes and time goes by the various changes occur in the dynamism which Dr. Kerwin spoke of as being extreme in these areas.

I support the travel suggestion. I do not know how far short we fall in the idea of travel now. We are doing fairly well in certain areas of travel. I am sure Senator Cameron would be glad to hear this.

The Chairman: Perhaps one thing which is not available is travel expenses to give an opportunity of meeting a group of colleagues, not necessarily at a meeting of learned societies but to visit a laboratory. I have attended many meetings of learned societies and I do not think they afford a proper climate for a very profound exchange of views.

Dr. Bell: We need something informal.

Senator Cameron: This is an asset. But are you going to say to a graduate student, working on some problem in biochemistry, that it

would be a good idea for him to visit a western university, one in Saskatchewan or Vancouver, or he could spend a week in Toronto? Do you think this is a good thing?

Dr. Frost: We are doing this to a limited extent.

Senator Cameron: Is it the consensus of this group that a total inventory of research projects is impracticable—that is the first thing—and then, if that is the case, is it possible to establish an inventory of areas of interest where this is being developed? Is there anything of that nature existing in Canada today?

[Translation]

The Chairman: Dr. Kerwin.

Dr. Kerwin: Mr. Chairman, I would like to point out that the idea of a Canadian inventory, whether it is extensive or taken in a given field, is not altogether practical, because the scientist of the humanist, who is interested in such a problem, well, it is true that he is interested in what is going on in Alberta or in Saskatchewan, but he is also interested to know what is going on in New York, in Mexico City or in Buenos Aires.

In order to be practical, such an inventory must be global and I would prefer that Canada associate itself with international organizations such as UNESCO and IXOU to elaborate such an international system because, in a given field, there is usually, for the natural sciences, at least some twenty laboratories, of which one or two are in Canada, and then to invest a lot of money to find out about such a small fraction is not worth it.

I would prefer that Canada invest the same amount of money to help international systems.

There is now an embryo system in the United States, and it is, up to now, what we have found the most useful. It is a system by which we receive every week, every Monday, the list of the publications we are interested in; it is done by computers and, for my sector, it is what we have found the most useful. But its strength is that it is international; if it covered only what is being done in the United States, it would already be less interesting.

[Text]

Dr. McDougall: I think I can add two more instances to the sources of information on research. We have got one in a geological survey in Canada which publishes a summary

of research in the geological sciences. This comes out quite some time after it has been compiled.

Another one, which comes out at intervals, is a list of research projects in Ontario, published by the Ontario Research Foundation, which covers quite a broad field but is mainly limited to things that the Ontario Research Foundation are interested in. Some of it is industry, some in laboratories and some in the university.

Senator Cameron: I do not wish to monopolize the questioning, but inevitably we will reach a stage where federal plus provincial funds are the main sources of financing of our research; and we are never going to have enough. Unless we have some pretty good idea of what is being done in each field, there is a possibility that some university or some research institute will be overlooked or neglected. We need some kind of guideline as to what is being done, where it is being done, and how much it is likely to cost. This is something that goes right back to the federal agency.

Dr. McDougall: In a very restricted field, of course, you can more or less keep abreast of this sort of thing. One thing which it might be worthwhile considering in some fashion is something that was done in the United States in the past. The National Science Foundation, starting I think about 1925, was very interested in the development of radioactive dating of geological material. From 1925 until sometime during the war, and subsequently for a few years afterwards, they issued a series of papers which summarized this. They had major papers and they kept a running list of activities in different laboratories, on a worldwide basis, which were considering some of these problems in the radioactive dating of geological material. This is a source back in history of something which might be considered. It took a very dedicated individual to carry this out. It meant corresponding with laboratories all over the world. It was on a personal basis, actually, and also took up a great deal of time in abstracting the papers which were sent in. It takes some kind of organization to do this. At that time it provided a very clearcut picture of what is happening on a worldwide basis.

Senator Bourget: May I ask if these gentlemen would be in favour of setting up a department of science and technology or if they have thought about it or about some other kind of mechanism which would co-

ordinate our science policy or science projects here in Canada.

[Translation]

Dr. L'Abbé, have you thought about it?

Dr. L'Abbé: After all, like many others, considering the multiplication to-day of the organizations which are engaged in science policy or in carrying out research work, it seems clear that something of the sort becomes essential. Must it take the shape of a Department of Science and Technology, an agency which has therefore not only a consultative role, but also an executive one? Personally, it seems to me that this is a thing toward which we should tend, but maybe not directly, otherwise we always have committees or advisory councils which make recommendations, but, in the end, the decision makers are somewhat dissociated from the motivations which permitted the formulation of the recommendations, and I am afraid that, at that time, the consultative and the executive become too dissociated. It would seem that, eventually, the responsibility should be given to those who were able to convince themselves of the merits of the decisions they will put into effect.

[Text]

Dr. Frost: We have talked about this several times at McGill and our opinion has been that the spectrum of interest we covered is so great that one ministry of science and technology could never hope to cope with the whole field. It is true that you do get a certain amount of overlapping between different ministries, and, what is perhaps even more important, you get a number of interstices where they don't actually meet and there is a gap between the interests of the two fields. But, nevertheless, to envisage one ministry which attempted to cover the whole field would, in our opinion, be setting up an organization so gigantic that it would hardly be able to bring itself to bear on the very important and practical points that both science and technology have to deal with.

That, I think, is a consensus of opinion among my colleagues, as much as I have discussed this with them.

Senator Bourget: So one of our duties would be to report to Parliament what kind of mechanisms we should have.

The Chairman: As an alternative to this, do you think we should have a minister mainly responsible for overlooking science policy?

Dr. Frost: That would certainly commend itself much more clearly and, of course, there are examples of that particularly in Britain and on the Continent. To have a minister responsible for the general oversight, I think, would be an excellent thing, but to have one department would be to make this too large and the responsibility too manifold.

Senator Bourget: I am not speaking about one department. I am speaking of one man in charge, a minister or some other kind of mechanism. Through our inquiries since starting this committee, and I think I express the feeling of the members of the committee as a whole, we have found that there is some duplication in our research; so the purpose of it is to save money and then men as well, researchers.

[Translation]

The Chairman: Dr. Kerwin then.

Dr. Kerwin: For my part, Senator, I do not like too much the idea of a Minister of Science, and I share the views of Dr. Frost on the matter. Now, there is, none the less, a middle term, and indeed, from what I have studied, this middle term has been found by France. In France, science is the responsibility of a group of ministers, and this group, forming the Science Committee, is chaired by the prime minister himself, and, in general, the work is done by the very important man who is called the Delegate General. But, then, the total budget for French science is submitted to the House by a group of ministers and thus it does not compete with the other departments, and it is sponsored by the prime minister himself. I think that this middle term between on the one hand, one minister and on the other hand, no minister, as is now the case, or a group, this is maybe the middle term which would be suitable for Canada.

The Chairman: Senator Hays.

[Text]

Senator Hays: Mr. Chairman, we have an inventory of all the research programs at universities and the students involved in them. Supposing a student at Bishop University is very bright and wishes to do research but there are no research facilities there in so far as his line of interest is concerned, and supposing further that he might very well be at Bishop for four or five years; do the universities give any consideration to calling such a particular student in because he can make a great contribution? Do they feel that he

should not be left at Bishop but should be at McGill or Laval where there are all the facilities to help him in his goal?

If you do have these types of inventories, then what do you have to say with respect to the sort of inventory of the kind of person we are teaching?

Professor Dutton: I think this is done consciously, Mr. Chairman. The constant preoccupation of the professor is to get his students to the place where they will get the most, produce the most, give the most and receive the most. I think we do this. It is an occupational hazard of being a professor.

Senator Hays: On the question of the budget, you mentioned, Dr. L'Abbé, that you thought 4 per cent was the goal. I don't know where you got the figure of 4 per cent. Perhaps it was from what the United States had spent in the field of research. You suggested that the goals should be out in three or four years. If my arithmetic is correct, we are speaking of something like \$3 billion.

You also mentioned that this should be the responsibility of the federal Government, and I think we are spending something like \$800 million now in the field of research at all levels in Canada. This would constitute about 25 per cent of the present federal budget, if we were to spend this amount of money.

Do you think that Canadians can afford to do so? Do you think we are losing by not spending more in the field of research? After all, we are talking about a lot of money when we talk of \$3 billion, or a figure close to that.

Dr. L'Abbé: It depends where you start: 1 per cent or 1½ per cent. As Professor Kerwin mentioned, perhaps the best idea will be to try to double our effort within a certain number of years, for example five years. You said that we have reached about \$1 billion a year now.

Senator Hays: Something less than a billion dollars; approximately \$870 million in all fields.

The Chairman: The total Canadian effort is about \$800 million at present, but the federal share of research and development would be only about \$400 million.

Dr. L'Abbé: But, if you compared development of the national budget over the last five years and projected that, I don't think there would be any difficulty.

Senator Hays: Would you tie it to the gross national product, which is something like \$68

billion, I think, in the federal field? This would be approximately \$2,600 or \$2,700 million in the field of research.

I am just putting a figure on it rather than tying up the programs. If we said to you that we were going to give you 400 per cent more this year than we did last year, could you spend it wisely? That is the question.

Dr. L'Abbé: We all agree in Canada that the viewpoint is applied science today. This is much more costly, of course, but it is also much more productive. So it looks like a big effort, but it might have lots of gains. Nobody will say that you have to do that for fundamental research. As you said, we perhaps could really accept all that and really feel responsible for it, but I think one has to very much point out that the need is for applied research and in applied research we are weak owing to very peculiar situations.

All applied research is more or less done in the United States. In the industrial plants here in Canada they are not really doing their share in Canada. They are not doing what they should do. Therefore, there is surely a bigger responsibility of the Government for that purpose.

Senator Carter: Mr. Chairman, one of the witnesses earlier mentioned that one of the universities, Laval or the University of Montreal, I am not sure which, had already compiled an inventory for the whole of the province of Quebec for the universities, and what I would like to know is how that inventory is being used. What use is being made of it?

[Translation]

Dr. Kerwin: It is not used very much, Senator, because of its primitive form. This exists since last year. A team had to be assembled, the six universities had to agree and then, a way had to be found to produce this document. Thus, this document consists of a complete list of the thesis subjects of all the graduate students at the six universities. This document is divided into parts: there is the list of students; there is the list of the theses; there is the list of the disciplines and fields; there is the list of the thesis directors. It is a document just about so thick. The conclusion we have reached, after this first experience, is that it is not the form, not only not ideal, but it is not even the practical form of the document to be produced. Consequently, our team is now considering the problem of making it much more useful. In particular, it seems to have reached the same conclusion as the one mentioned by Professor Bell that

this document should be divided into disciplines and should supply more details in a field more limited to various professors. We are conducting an experiment, but we do not anticipate that it will be a success; but the test must be made.

The Chairman: I am afraid we will have to come to a close, but before doing so I would like to ask a final question, if I may.

Dr. Ufford has mentioned briefly, a while ago, the problem of employment for university graduates. I wonder if our guests from French language universities have studied this problem. I have been told, for instance, that the number of students in the Department of Social Sciences at Laval University, two years ago, was around 800, and that it is now 1,600, thus it has doubled during the last two years; I wonder if they have considered that this could become a problem from the point of view of future graduates, in this field as in any others.

Dr. L'Abbé: Will you allow me to give a quick answer to this question, before I cede the floor to my colleague M. Kerwin, maybe.

The Chairman: The same situation probably prevails in Montreal.

Dr. L'Abbé: Yes, the phenomenon is probably even worse in Montreal. We have now more than 2,000 students in the Department of Social Sciences. Well, this year, I would say luckily, because there is really a difficulty concerning the placement of students, temporary maybe, but real; this year, the number of applications for admission is lower, which was anticipated. In fact, we are pacing ourselves to meet this difficulty by the creation of a second degree, a second cycle which would be much more professional. For instance, a doctorate in communications which would be available to graduates of quite specialized disciplines, such as political sciences or sociology, or linguistics, etc. I think that we have failed in not creating this type of a more professional degree which leans more on the profession, and which can more easily find an outlet. At the moment, our graduates, after a first specialized degree, are a little narrow in their knowledge and not too generalized, and thus must often retrain themselves in order to benefit from their first training which is a cultural and general training, but which could bring them on the labour market with a more professional bias.

The Chairman: But in the field, at the Science Faculty for instance, in Montreal, do you anticipate about the same problem or not?

Dr. L'Abbé: No, at the Science Faculty, we do not anticipate the same problem. We are even astonished that the number of applications for admission, and I believe it is worse at Laval, is so low. There is a craze for social sciences and letters which may be to the disadvantage of the science disciplines. With regards to engineering, the trend, of course, all over America, is to develop more and more engineering and especially at the graduate level, and we have not yet made this change, and we have not even taken steps to do it, but inevitably, it will become necessary, because it is certainly not by producing a great number of engineers of the first cycle that we will be able to meet the needs of the market from this point of view.

Senator Bourget: There is the Polytechnical School, where I was a student in 1932; since then, a great evolution took place in the sense that there is much more specialization now than in my time, 30 or 35 years ago.

Dr. L'Abbé: Yes, but it still is not enough at the master's or doctor's level; there are very few doctorates.

Senator Bourget: Yes, very few, unfortunately.

Dr. Kerwin: Mr. Chairman, at Laval, it is the opposite with regard to engineering. Our engineering departments are among those where the rate of research performed is the highest in Canada but, except for this, I agree with Dr. L'Abbé's remarks, we have about the same situations in the human and social sciences. I will add that, sometimes, the evolution of a university is not necessarily logical in its context, and we are subject to social pressures. Thus, until very recently, the labour market has been able to absorb all the graduates in social sciences that we could produce. Now, this is changing and there are a great deal less positions available, and the first reaction of the students who are unable

to find work is to remain in graduate school, which is not logical, but which creates problems for us.

Dr. L'Abbé: Now, Honourable Senators, please allow me to add a remark. In certain fields of social sciences, as we have noticed, we have a very high rate of excellence and this, consequently, would allow our graduates to leave the country, well, maybe not the country but Quebec at least.

The Chairman: As I said yesterday, to go to foreign provinces.

Dr. L'Abbé: Yes. I point out, for instance, that in anthropology, we have, evidently, in Montreal a department which forms a team that is quite remarkable at the international level. Naturally, we do not need a very great number of anthropologists in Quebec itself, but Canada certainly does, and other countries too, and we could certainly, at that time, think of outlets for our graduates which would be, let us say, in the whole of Canada, and in other country, perforce in the under-developed countries, in particular those where we would participate actively.

The Chairman: Therefore, you do not see any surpluses developing within these universities, except in the field of letters and social sciences?

Dr. L'Abbé: Well, please note that in letters even, we must be careful because the teachers' market can absorb many, except maybe in certain fields where there is a recession, even at the level of secondary education, considering the options which are being introduced. For example, history loses its value, the classical languages, of course, have nearly disappeared.

The Chairman: I wish to thank our guests this morning. I think we have had a good day during which we have had discussions which, for me at least, were very interesting.

On behalf of my colleagues, I wish to thank everyone around this table this morning for this very interesting discussion.

The Committee adjourned.

APPENDIX 67

SCIENCE POLICY

IN CANADA

A Brief submitted by
Laval University, the University of Montreal
and the University of Sherbrooke
to the
Senate Committee on Science Policy

May, 1969

The French-language universities of the province of Quebec have decided to submit a common brief outlining their views on the problems faced by universities in their research activities. In response to the need for a new conception of the nature of the university, and as a result of the major contribution made by the state and by the business community to scientific progress, it is of primary importance that the universities seek to co-ordinate their own research policies. This brief is a step in that direction.

A research policy of this kind, however, cannot be divorced from an overall science policy. In presenting our views on the problems posed by university research, we wish to emphasize the need for close co-operation between the parties involved in the conduct or financing of research: governments, industry, labour unions and other groups. Such co-operation seems to us essential to the avoidance of useless duplication of effort and expense, and the ensuring of harmonious development in the various fields of research accompanied by the exchange of scientific knowledge, with constant thought being given to the research needs revealed by society.

In so doing, we make no prior judgment whatsoever of any possible future agreements or changes in the political situation involving the federal and Quebec governments, nor of the constitutional option towards which Quebec might lean in the future. Faced with present realities which demand immediate action, we choose rather to analyse the current situation, and in making recommendations, we shall limit ourselves to those which are capable of immediate implementation within the political and constitutional context of today.

I - RESEARCH AND CANADIAN SOCIETY

Since numerous studies have adequately demonstrated the importance of research in the achievement of social progress, no purpose would be served by dwelling on the point. That science, and the technology it engenders, have played a pre-eminent role in the development of the advanced industrial society is a commonly agreed point, and it will suffice to add that the acceleration in that development demands an increased research effort. It is imperative that the responsible authorities - governments, industry and the university community - agree to devote a greater part of the gross national product to research.

We are anxious to stress two features of Canadian society which should be reflected in any science policy, the first is its pluralistic nature, the second is the individual character of the Canadian economy.

(a) Canada's Pluralist Society

For historical and geographical reasons, different parts of Canada have developed at different rates, leading to the creation of regional disparities. Only through the implementation of economic policies agreed upon by the federal government and those of the provinces can such disparities be reduced in the future. However, no policy can succeed in obviating the individual needs of the various regions, and it would be ill-advised, if not actually harmful, to attempt to chart a single course for economic development in the Maritime and Prairie Provinces, or in Quebec and British Columbia.

Similarly, a science policy for Canada needs to be pluralistic, both in its objectives and in its implementation, so as not to confine regional policies to a straitjacket.

Two extremes must be avoided: we must not attempt development of every kind of scientific activity in every region, nor must we lead each region to specialize in one field.

Moreover, the cultural plurality of Canadian society, to say nothing of our national duality, implies that any overall science policy should refrain from opposing, or even re-directing, individual policies that may be espoused by any of the cultural communities that together constitute the Canadian people. On the contrary, a science policy for Canada must be based on this objective reality, and must comprise the sum of the directions in which each of these communities wishes to progress.

We are aware that the concentration of the French-speaking community in the Province of Quebec lends a political and constitutional dimension to this question. We do not wish, in this brief, to suggest answers to - or even examine - the question; we merely wish to bring the problem to mind, and to insist that the constitutional debate be prevented from obstructing the development research.

(b) The Individuality of the Canadian Economy

Of the factors tending to hamper economic and scientific development in Canada, the following may be cited:

- (i) a small and predominantly youthful population;
- (ii) territorial vastness;
- (iii) an economy that is frequently dependent on outside stimuli;
- (iv) the proximity of the United States.

In view of the foregoing, Canadian science policy must establish objectives that will allow us to preserve our autonomy, bearing in mind the resources that are available to us. The primary objective is the

maintenance of balanced development in the various fields of scientific activity that are essential to a complete society. This objective, however, minimal though it is, will not be sufficient to end Canadian dependence on scientific and technological innovation originating abroad.

It is essential that our science policy concentrate on selected areas that are compatible with Canadian individuality. Thus, research in such fields as transport, communications, water use and conservation, northern development and inter-cultural relations would enable Canada to meet her own special needs. Such a policy would also foster the creation of centres where first-rate work would be carried on, thus making a major contribution to the international scientific community.

II - RESEARCH AT THE UNIVERSITIES

University research, as an activity involving both the expansion and distribution of knowledge, is an essential pursuit, closely linked to that of education. The two are complementary and mutually self-generating. The symbiosis between education and research achieves its highest expression in programs leading to masters' and doctors' degrees. This fact offers a reminder that universities are not mere research factories, but provide the best possible environment for training researchers; the importance for scientific progress of the contribution they make in this area cannot be ignored. The effort made over the last few years to encourage students to pursue post-graduate studies must be maintained, and even intensified.

Apart from the expansion of knowledge, research contributes to the greater well-being of society through technological innovations

resulting from scientific discoveries. Universities cannot neglect this aspect.

The time has come to encourage greater merging of the activities of universities with those of government research institutions, with due respect for the proper concern of each - the universities being oriented more towards basic research, government institutions towards applied research.

In order for them to work in a truly effective way, it will be important for them to establish a system for the exchange of information regarding their findings, as well as exchanges of researchers and trainees. This will involve the maintenance of working arrangements for communication within the scientific community to which they belong. The latter point seems to us to be of crucial importance insofar as inter-discipline research is concerned.

Work in the last-named field has lead to the relatively recent idea of mission-oriented or combined research, and here the distinction between basic research and applied research tends to break down. The subjects of such inter-discipline research, particularly in those cases where "natural" scientists call upon "social" scientists or vice versa, relate to problems brought on by modern technology and social evolution, such as pollution, urban problems and public health.

The large capital and operating outlays involved in such projects require close co-operation between universities, between the federal and provincial governments and between universities and governments if costly duplication and wasted effort are to be avoided. It is also essential that a system of priorities be established, based on criteria drawn

up not by the central authority alone, but by all the agencies concerned.

The financing of large-scale research programs presents a two-fold problem, particularly when they are carried out in an institutional context. Firstly, there must be some sort of guaranteed program financing. We recommend that those in charge of programs be able to rely on subsidies spread over three years; once the three-year initial subsidy has been granted, the subsidizing agency should inform the recipient at the end of each year as to whether the subsidy is to be continued for a further year. In this way, program directors would always have a three-year margin in which to plan for the continuation or cessation of their work.

Secondly, rules would have to be laid down whereby a research program could be terminated if the conditions that lead to its setting up had ceased to apply, either because its objective had been poorly-defined in the first place, or because changing circumstances had destroyed its usefulness, and therewith its claim to priority.

Major research and development programs also involve a contribution from the private industrial sector. In this field, we believe that industry must participate in the achievement of the overall objectives of the state. That is, it must involve itself, and must be encouraged to involve itself, in research programs calculated to further the economic and social development of the country; in so doing, it is but ensuring its own survival. It is important for industry to co-operate with government and with the universities in order to foster technological innovation. Industry will have to depend more on research that is, or could be, done in the universities; this could be a means of ensuring a decentralization of industry and improved specialization in individual universities.

III - RESEARCH AND THE FRENCH-LANGUAGE UNIVERSITIES

For a complex of reasons that have been discussed in several published works, the French-language universities have developed more slowly than the English-language group, with some notable exceptions in a few subjects. Thanks, however, to efforts to catch up on the part of small groups, and to a policy of individual excellence, these universities are now well supplied with researchers and basic structures and equipment. The proportion of post-graduate degree students has now reached the average level for Canada, their researchers now obtain just as many individual grants in open competition with their English-speaking colleagues, and the portion of their budgets devoted to research is close to the Canadian average.

This basis must be used for the development of a recruitment policy suited to the establishment of large research centres through the hiring of experienced researchers, in order to achieve a balance in the teaching staff, and to the formation of research teams staffed by the researchers themselves and their assistants and associates. Once these teams are established around well defined programs, they will make it possible to invite researchers from other universities, to attract young scholarship-holders with doctors' degrees and to improve post-graduate courses. In a few cases, where the size of investments and the interdisciplinary character of the work require it, universities must be able to set up research centres.

These reforms would have a number of financial consequences, resulting from the recruitment of experienced researchers, the transfer of staff from teaching to research, the acceleration in the training of

research or study directors, or the introduction of students into research teams by means of scholarships. There are certain basic obstacles resulting from present financing methods, because of the inadequacy of the material resources at our disposal and because of the difficulties experienced by younger members of our teaching staff in obtaining grants, under a system which is based on merit and has only recently taken account of historical and cultural differences between institutions located in different communities.

The individual character of the subsidies granted by federal agencies places the French-language universities of Quebec at a disadvantage, in view of the number of French-speaking researchers in relation to their English-speaking counterparts, and the fact that the criteria on which awards are based do not favour young applicants. The federal government has not made sufficient allowance for the fact that, for historical and geographical reasons, the French-language universities have more difficulty in recruiting the experienced teachers whose high academic standing entitles them to the larger research subsidies.

Furthermore, staffing developments in federal agencies very largely ensure English-speaking control of the Canadian scientific community. Though those concerned may be unaware of it, this situation works to the advantage of official liaison between English-speaking researchers and federal agencies. It must be recognized that this creates a psychological climate that is less than inviting for French-speaking researchers.

Moreover, the federal government has established an impressive number of regional laboratories or research institutes throughout Canada. Capital investment has been vast, and operating costs are considerable.

These regional research centres are a valuable asset for universities located in their vicinity, either through actual co-operation between federal laboratories and universities, through the outlets they provide for students during their vacations, or through their researchers' participation in graduate teaching. One thing is certain: Quebec's share of the benefits flowing from such federal institutions is minimal insofar as the development of research within the province is concerned. Thus, not only have Quebec's taxpayers contributed their fair share to the establishment of federal government laboratories in Ottawa, they have also subsidized regional research activities with federal funds that are spent more generously elsewhere than they are in Quebec.

The total paid by the federal government in subsidies to Quebec's French-language universities reveals a basic problem. The figures for 1967-68, for example, show that out of a national total in federal subsidies of \$72,481,000, the three French-language universities in Quebec received \$8,046,000, or 11.1%.

It is important for the federal government's policy to be realistic, and to reflect a pluralistic view of the university research situation. The agencies responsible for subsidizing research should take existing disparities into account, particularly where the French-language universities are concerned.

The French-language universities, then, are ready to experience the growth in scientific activity that occurred in several English-language universities thirty years ago, at a time when the roots of a number of large growth centres were being laid down. We therefore recommend that the federal government use its offices to capitalize immediately

on this opportunity for expansion in Canadian scientific activity. Laval University and the Universities of Montreal and Sherbrooke must be the sites for the establishment, within five years, of several large laboratories or research centres; in a few special cases, this could be done preferably through the medium of inter-university or university-government installations. Appropriate precedents currently exist in French Canada, and our recommendation, in essence, is that the present policy be applied on a broader scale. We further recommend that the federal government establish unilingual French-language research laboratories in Quebec, and that close ties be developed between such laboratories and the universities.

IV - CANADA'S SCIENCE POLICY

We believe that the drawing up of a national science policy for Canada must hinge on the following guiding principles:

1. The cultural and regional plurality of Canadian society;
2. Economic resources and limitations, and the designation of areas of special concern;
3. Exchanges of researchers and information between universities and federal and provincial government agencies;
4. The development of inter-discipline research through co-ordinated establishment of priorities and financing arrangements by all the parties concerned;
5. Industry participation in research and development programs;
6. Revision of the machinery for granting research subsidies and of the make-up of federal research agencies, in order to take account of the availability and willingness of the French-language universities to participate in scientific growth.

Special Committee

Canadian University Research Budgetsin Thousands of Dollars

| | <u>1965-66</u> | | | | <u>1966-67</u> | | | |
|---------------------------------|------------------------|-------|-------------------------------|------|------------------------|-------|-------------------------------|------|
| | <u>Research Budget</u> | | <u>Total Operating Budget</u> | | <u>Research Budget</u> | | <u>Total Operating Budget</u> | |
| Laval | 2,704 | 14.4% | 18,849 | 100% | 3,450 | 14.7% | 23,507 | 100% |
| Montreal | 2,687 | 14.2% | 18,878 | 100% | 3,815 | 15.7% | 24,240 | 100% |
| Sherbrooke | 80 | 2.1% | 3,745 | 100% | 234 | 4.2% | 5,608 | 100% |
| <u>Total</u> | 5,471 | 13.2% | 41,472 | 100% | 7,499 | 14.1% | 55,355 | 100% |
| A11 Canadian Universities | 60,772 | 17.3% | 350,560 | 100% | 79,622 | 16.7% | 480,829 | 100% |

Source: Annual Report of the Canadian Association of University

Business Officers (CAUBO)

22-5-1969

Breakdown of Full-Time Professors by Rankin All Facultiesexcept Medicine and NursingLaval, Montreal and Sherbrooke Universities

| | <u>1966-67</u> | <u>1967-68</u> |
|----------------------|-------------------|-------------------|
| Full Professors | 199 (16.7) | 224 (18.1) |
| Associate Professors | 260 (21.8) | 281 (22.7) |
| Assistant Professors | 459 (38.4) | 468 (37.9) |
| Study Directors | <u>275 (23.0)</u> | <u>261 (21.1)</u> |
| Total | 1193 (100.0) | 1234 (100.0) |

13 Canadian Universities *

| | <u>1966-67</u> | <u>1967-68</u> |
|----------------------|-------------------|-------------------|
| Full Professors | 1363 (21.5) | 1528 (22.4) |
| Associate Professors | 1749 (27.6) | 2009 (28.2) |
| Assistant Professors | 2420 (38.2) | 2745 (39.0) |
| Study Directors | <u>812 (12.8)</u> | <u>771 (10.9)</u> |
| Total | 6344 (100.0) | 7053 (100.0) |

* Dalhousie, New Brunswick, McGill, Carleton, Queen's, McMaster, Western Ontario, Toronto, Manitoba, Saskatchewan, Calgary, Alberta, U.B.C.

Source: C.A.U.T. Pay Research Bureau (1967-68): 68-82

Federal Government Subsidies for Research

in Canadian Universities

(in Thousands of Dollars)

| | Federal Total | | Quebec Total | | Total, French-Language Universities | |
|--|---------------|---------|----------------|----------------|-------------------------------------|---------------|
| | 1966-67 | 1967-68 | 1966-67 | 1967-68 | 1966-67 | 1967-68 |
| National Research Council | 29,158 | 40,268 | 5,180 (17.7%) | 7,042 (17.5%) | 2,606 (8.7%) | 4,066 (10.1%) |
| Medical Research Council | 12,100 | 17,565 | 3,488 (28.8%) | 6,203 (35.3%) | 1,431 (11.1%) | 2,538 (14.4%) |
| Defence Research Board | 2,456 | 2,821 | 590 (24.0%) | 663 (23.5%) | 237 (9.6%) | 295 (10.5%) |
| Canada Council | 983 | 2,102 | 279 (28.4%) | 455 (25.6%) | 184 (18.7%) | 300 (14.3%) |
| Central Mortgage and Housing Corporation | 141 | 519 | 56 (39.7%) | 147 (28.3%) | 56 (39.7%) | 134 (25.8%) |
| Atomic Energy of Canada, Ltd. | 461 | 519 | 150 (32.5%) | 172 (33.1%) | 113 (24.5%) | 132 (25.7%) |
| Fisheries Research Board | 280 | 428 | 19 (6.8%) | 8 (1.9%) | 0 (0%) | 0 (0%) |
| Departments: | | | | | | |
| Indian Affairs | 427 | 461 | 80 (18.7%) | 63 (13.7%) | 66 (15.4%) | 45 (9.7%) |
| Agriculture | 445 | 625 | 101 (22.7%) | 131 (20.9%) | 31 (6.9%) | 37 (5.9%) |
| Energy, Mines and Resources | 410 | 627 | 80 (19.5%) | 77 (12.3%) | 46 (11.2%) | 45 (7.2%) |
| Forestry and Rural Development | 243 | 351 | 59 (24.3%) | 115 (32.7%) | 17 (7.0%) | 20 (5.7%) |
| Industry | 1,483 | 222 | 1,442 (97.2%) | 58 (25.9%) | 0 (0%) | 0 (0%) |
| National Health and Welfare | 4,384 | 4,856 | 779 (17.7%) | 703 (14.5%) | 430 (9.8%) | 37 (7.9%) |
| Transport | 211 | 313 | 86 (40.7%) | 101 (32.3%) | 5 (2.4%) | 10 (3.2%) |
| Labour | 113 | 97 | 30 (26.5%) | 25 (25.7%) | 14 (12.4%) | 18 (18.5%) |
| Others | 458 | 707 | 137 (30.0%) | 200 (28.3%) | 65 (14.4%) | 33 (4.7%) |
| Total | 53,753 | 72,481 | 12,556 (23.4%) | 16,163 (22.3%) | 5,301 (9.9%) | 8,046 (11.1%) |

Source: Research Expenditures in the University Community

Department of the Secretary of State, Canada (1968)

April, 1969.

FEDERAL GOVERNMENT LABORATORIES

(other than departmental)

National Research Council

All laboratories are located in

Ottawa, except for:

The Atlantic Regional Laboratory

(Dalhousie University, Halifax)

The Prairie Regional Laboratory

(University of Saskatchewan,
Saskatoon)Fisheries Research Board

Biological Research Stations:

St. Andrews, N.B.
St. John's, Nfld.
Ste. Anne de Bellevue, P.Q.
(English-language)
Winnipeg, Man.
Nanaimo, B.C.

Oceanographical:

Dartmouth, N.S.
Nanaimo, B.C.

Technological:

Halifax, N.S.
Grande-Rivière, P.Q.
St. John's, Nfld.
Winnipeg, Man.
Vancouver, B.C.Defence Research BoardThe Defence Research Establishment,
Atlantic

Dartmouth, N.S.

The Canadian Armament Research and
Development Establishment

Valcartier, P.Q.

The Defence Chemical, Biological and
Radiation Establishment

Shirley Bay, Ont.

The Defence Research Board Tele-
communications Establishment

Shirley Bay, Ont.

The Defence Research Establishment,
Toronto

Downsview, Ont.

The Defence Research Establishment,
Suffield

Ralston, Alta.

The Defence Research Establishment,
Pacific

Esquimalt, B.C.

Atomic Energy of Canada, Ltd.

Chalk River Laboratories

Ontario

Whiteshell Laboratories

Pinawa, Man.

APPENDIX 68

BRIEF
TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

FROM

THE FACULTY OF ENGINEERING

LOYOLA COLLEGE

MONTREAL

SCIENCE POLICY AND HIGHER EDUCATION

George W. Joly,
Dean of the Faculty

Montreal,
February 27, 1969.

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1. LEADERS OF THE 1990s

Those who will be the leaders of society in the last decade of the 20th century will -- all of them -- be preparing themselves in the 1970s for this leadership. The majority of them will be doing so in an organized fashion -- enrolment in a university -- the only structure at the present time acknowledged to be the training ground for leaders.

2. THE TASK OF THE LEADERS OF THE 1990s

1. The nature of the training for leadership which the universities should be offering in the 1970s may be judged by looking at the nature of society today, and from this forecasting what it might be like in the 1990s.
2.
 1. In 1969, our society is one wherein technology has a firm grasp on the citizen, whether he consents to the grasp or not. As a predominantly urban dweller, the citizen must depend on others for his livelihood, and what "others" offer him, is mainly work in industry. Whatever industry the citizen accepts an offer to work in, it will be technologically oriented. If, by chance, it is not, then it will not survive to the 1990s.
 2. All societies on the planet, whatever their political nature, have embraced technology. Not only embraced it, but embraced it willingly. Hence, barring an atomic holocaust and a possible consequent return to barbarism, technology will still be here in the 1990s and exert an increasing

2.2 (Cont'd)

dominion over men's lives. If it is possible, here and there in 1969, as in agriculture, to earn a livelihood free of technological content, it will not be possible in the 1990s. Agriculture will be by then completely subjected to technology.

3. 1. A citizen in the '90s, who will aspire to lead a society of his fellows for his and their good, will have to know how to control the technology that will be the main contributor to their real or apparent good.
2. To control technology is to make decisions about its objectives. This is, of course, the nature of control over anything.
3. Making decisions about objectives is assigning value to these objectives. Learning how to assign value must, then, be part of the training of a leader.
4. 1. The assignment of value has, traditionally, been the task of humane studies. But the humane arts teach only how to assign value to men's actions because their

3.4.1 (Cont'd)

proper object is man and his actions. They have not assigned, and of their nature cannot assign, value to things.

2. "Things" have no "value" in the humane sense.

Some of "them" may be assigned value in assessing the value of a man's actions, but such "things" are elementary: food, clothes, shelter.

3. Technology is "things" and "they" are not elementary. "They" are complicated. "They" are electronic circuits. "They" are atomic structures and inter-actions. "They" are computers and the control that the latter "things" can exercise over other "things", like the production of goods.

4. 1. He who would assign value to the "things" of technology as they bear on men must make the "things" of technology one of the objects of his studies.

2. He who would attempt to assign value to the "things" of technology without first having made them the proper

4.2 (Cont'd)

object of his study would be making decisions comparable to the ones about how many angels could dance on the head of a pin.

3. He who would attempt to assign value to the "things" of technology without knowing how to assign value to the men for whom these "things" are made would be making decisions comparable to those of the technologists of China who in the 1950s set up living communes for the workers in order to increase productivity by eliminating the workers' time spent with their families. The goal of technology, per se, is the 100% efficient use of things - and of men.

5. Hence the task of a leader in the '90s will be to make decisions about the objectives of technology, based, at the lower level, on his grasp of the nature of its "things", and based at the higher level, on the value to be assigned these "things" in their relation to that greater "thing" -- man.

3. THE ORGANIZATION OF THE UNIVERSITY

1. INTRODUCTION

1. 1. To offer young citizens in the 1970s a formation for the leadership described above would require a re-structuring of higher education.

2. 1. The assignment of value to men and the assignment of value to things that has been postulated above as the foundation of leadership are in the current Canadian university presented in "Two Solitudes". Men are studied in Arts and "things" in Science - Engineering.

2. The relation between these two entities of the university might be described as "foreign".

2. 1. A university structure that might favor the formation of young citizens according to the ideas already described is outlined below.

2. Since no fiat can create a university structure an evolution of the present structures would have to occur, slowly at first, but accelerating, as 1980 approached.

2. UNDERGRADUATE DEGREE

1. COLLEGES

1. A College would be an administrative entity for students and program consisting of a Dean and a staff of 25 for each 500 freshmen.
2. The College would be responsible for the guidance of the 500 freshmen for four years, that is, until graduation.
3. A new College would be constituted every September for the freshmen entering and it (academic members) would be dissolved when these freshmen had graduated.

2. STAFF

1. The Staff would consist of 25 representatives - one from each of the major areas described under CURRICULUM, below.
2. Normally, a member of the Staff would remain with the College until its dissolution.
3. Members of the Staff would be promoted by the College itself, subject to appropriate consultation

2.2.3 (Cont'd)

with bodies outside the College.

4. Members of Staff would be chiefly engaged in undergraduate teaching while members of the College. They might however, present graduate courses.

5. 1. The Staff would be appointed by the Senate and/or the Board of Governors in the year preceding the formation of the College.

2. The 25 Staff members would elect the Dean.

3. At the end of the first year of the College, a majority of the students and a majority of the Staff, jointly, could nominate a replacement for the Dean or any member of the Staff.

3. GRADUATE DEGREES

1. DEPARTMENTS

1. Departments would be academic entities consisting of all members of the Staff of the university working in the same area of knowledge.

2. 1. The department would be responsible to the Senate for the state of the discipline in the university.

3.1.2 (Cont'd)

2. The department would be responsible for supplying teachers for each college course.
3. The department would be responsible for the guidance of graduate students in its discipline by supplying them with directors of studies.

2. THE STAFF

1. The Staff would comprise,
 1. Those members of the College working in the department's area.
 2. Directors of graduate students.
 3. Other personnel, not members of a College.
2. Directors of graduate students, and other persons not members of a College would be promoted by the department.
3. All ranks would be portable to or from a College and a department.
4. All members of a department would elect a Chairman.

4. THE STUDENTS

1. 1. In the long run, students entering university would normally register in a general program lasting four years.
2. The present secondary school curriculum of today would be adequate. However, students aspiring to go on to the university described in this paper would have to be guided in selecting courses that would be prerequisites for university.
2. 1. Normally, entrants would be oriented towards the development of industry, or education, or government.
2. Specialization in any discipline would be offered at the graduate level only.
3. It would be assumed that most entrants would aspire to specialization in graduate school.

5. THE CURRICULUM

1. 1. The Curriculum would consist of 30 courses in four areas, Liberal Arts, Science, Engineering, Commerce.
2. At present, the number of courses in most universities varies from 21 in Arts to 35 to 40 in Engineering.
2. 1. The Liberal Arts (12 courses)
 1. Empirical: 1. Psychology, Sociology, Communications Arts.
2. 3 to 4 courses.
 2. Factual: 1. History, Language as reading and talking, Political Science.
2. 3 to 4 courses.
 3. Subjective: 1. Literature in any language.
2. 3 to 4 courses.
 4. Speculative: 1. Philosophy, Theology
2. 3 to 4 courses.
2. Science (6 courses)
 1. Physics: Light and Electricity & Magnetism
 2. Chemistry: General Chemistry, Physical Chemistry
 3. Mathematics: Vector Algebra, Calculus.

2. (Cont'd)

3. Engineering (9 courses)

1. Mechanics and Materials 2 courses
2. Graphics 1 course
3. Electrical Machines 1 course
4. Heat transfer 1 course
5. Fluid Mechanics 1 course
6. Computers 3 courses.

4. Commerce (3 courses)

1. Economics: 2 courses
2. Accounting: 1 course

6. CONCLUSIONS

In making a new synthesis of knowledge for tomorrow's leaders, there would have to be a re-organization of the University where the synthesis would be made. Secondary benefits of some value to society would flow from the re-organization.

1. 1. The depersonalization that freshmen claim they suffer on entering university would be arrested. They would become a member of a College of not more than 500 and would remain in it until graduation.
2. They would be guided for four years by the same Staff -- the Dean and his 25 teachers.
2. 1. The freshmen would be presented with a long-range objective - leadership in business, education or government - and provided with a formation which they could easily see prepared them for the task.
2. The "relevance" of this education to life might bring peace back to the campus.

3.
 1. Changing the role of university departments from the formation of undergraduates to the formation of graduate students would free its members from many administrative tasks which they find unprofitable to the advancement of the discipline.
 2. The rewards for teaching versus the rewards for research would be equalized. Teachers would seek to join the Colleges which would now have become responsible for their advancement.
4.
 1. The instituting of a new College every four years would require a fresh approach to goals and curricula, every four years, at least.
 2. The dissolution of a College every four years would inhibit the development of vested interests in a status quo.
5.
 1. A student attending the university described above would have to commit himself to a discipline of self-organization for four years.

5. (Cont'd)

2. This would demand from others not prepared to commit themselves a serious examination of alternative forms of education, e.g., junior college

7. RECOMMENDATION TO THE SENATE

1. That a national committee of the Senate be set up made up of citizens who are equally at ease in the Liberal Arts and in Technology, to consider the feasibility of initiating in 1970 a pilot project of the program of studies outlined above.
2. That if such a program were initiated, the Senate consider the feasibility of paying fees for the individual student enrolled in it, in an amount reflecting the true cost to the university of enrolling him.

APPENDIX 69

BRIEF

SUBMITTED TO THE SENATE SPECIAL
COMMITTEE ON SCIENCE POLICY

BY

FACULTY OF SCIENCE, LOYOLA COLLEGE
MONTREAL

The Faculty of Science of Loyola College, is in an unusual but not necessarily unique position among Canadian university-level institutions.

Virtually all other Canadian Faculties of Science support, or are in a position to support, scientific teaching and research at the graduate level. Because of this, these other institutions are in a preferred position to attract and hold research-oriented professors. Above average undergraduate students are also more likely to be attracted to such institutions in the belief that the instruction will be superior. The provision of funds for research at the graduate school level is generally more liberal, based partially on the premise that graduate schools provide training for future scientists, and partially on the fact that research programmes may be more productive with the combination of the research-oriented professor to supply direction and longer-term continuity, and graduate students to carry out specific phases of the programme.

Special Committee

Despite the current and probable long-term undergraduate character of Loyola College, the Faculty of Science has managed to maintain a well qualified staff of professors. However, a number of promising young professors have left after a few years in order to join other institutions with superior research facilities, and other well-qualified individuals have refused appointments because of lack of graduate students to assist in research.

There seems little doubt that one feature which has helped to maintain the high calibre of the teaching staff has been the encouragement by the College of scientific research by members of the Faculty. This has taken a variety of forms, ranging from consideration of a professor's scientific productivity as part of the criteria for advancement, to partial financial support of research projects. Financial support by the College has consisted mainly of purchases of specialized equipment, where it can be shown that the equipment can be used for undergraduate instruction, and salaries of technicians who are primarily concerned with the construction and maintenance of equipment for undergraduate instruction, and only secondarily with research projects.

In some instances the College has provided partial or complete salaries for research assistants. However, the onus is generally on the individual professor to obtain funds to carry out his research. The principal source of such funds has been the National Research Council of Canada, with some grants from other government bodies such as the Defence Research Board and the Geological Survey of Canada. In a few instances funds have been obtained from private industry and other sources. As a general statement, operational grants from the National Research Council are small, and it is difficult to obtain major equipment grants or funds to support full-time research assistants. As a further general statement, the justification for this granting policy is that, because of the undergraduate nature of Loyola, most research will be done intermittently by individual professors working alone, and that sustained research on a year round basis or large scale research projects are not feasible.

It is the judgment of a number of the members of the faculty that the policy of the National Research Council towards an institution such as Loyola is generally generous, but in some areas may be somewhat short sighted. A number of members of the faculty have demonstrated their ability to carry out excellent research programmes on a sustained basis.

Special Committee

Some of them have expressed the opinion that more major equipment funds should be available in order to improve research facilities, but a more common opinion has been that skilled technicians and/or research assistants would be more effective in increasing scientific productivity. Quite probably the increase in productivity would be greater than that obtained from equivalent amounts spent to support graduate students. The rationale of their opinion is that a single well-trained technician or research assistant, working on a long-term basis, is probably more effective than a number of graduate students. It has also been suggested that, at an institution such as Loyola, the level of undergraduate instruction and orientation towards graduate-level research may in fact be superior to that at institutions with graduate schools, since our undergraduates are probably more aware of their professor's need to keep abreast of scientific developments, as well as their methods of carrying on research.

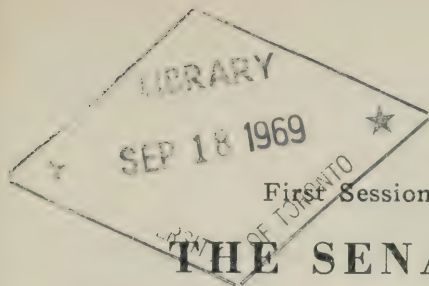
The following composite recommendation is submitted for the consideration of the Special Committee on Science Policy.

A considerable advantage would be gained for scientific research at undergraduate institutions such as Loyola if means could be found to increase the availability of research assistants and research technicians. This might be effected in several ways:-

1. Greater consideration might be given by granting organizations, such as the National Research Council, to individual requests for funds to employ assistants.
2. Consideration might be given to groups of researchers with more or less common interests, whereby they would be enabled to employ technicians or assistants on a long-term "pooled" basis. The existing regulations for N.R.C. Negotiated Development grants do not appear to provide for such an arrangement.
3. Consideration might be given to the establishment of an organization which has as its principal object the promotion of a policy of collaboration on research between undergraduate colleges, universities, and government or industrial laboratories.

To a considerable extent, this is being done through private arrangements on an individual basis. but the policy from institution to institution and from laboratory to laboratory varies considerably. If a uniform policy of collaboration could be established, it would appear to have the double advantage of improving the availability of skilled assistants as well as making more efficient use of expensive units of equipment.

Respectfully submitted by
D.J.McDougall,
for the Faculty of Science,
Loyola College



First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS OF THE SPECIAL COMMITTEE ON SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 47

WEDNESDAY, MAY 28th, 1969

WITNESSES:

Dr. B. M. Millman, Chairman of the Committee on Graduate Studies and Research, Brock University, St. Catharines, Ontario; Dr. G. D. Cormack, Associate Professor, Faculty of Engineering, Carleton University, Ottawa, Ontario; Dr. John Hart, Dean of Science, Lakehead University, Port Arthur, Ontario; Dr. G. A. Harrower, Vice-Principal (Academic), Queens University, Kingston, Ontario; Rev. Dr. Marcel Patry, O.M.I., Rector, St. Paul University, Ottawa, Ontario; Dr. M. Chagnon, Vice-Rector (Academic Affairs), University of Ottawa, Ottawa, Ontario; Dr. G. de B. Robinson, Vice-President, (Research), University of Toronto, Toronto, Ontario; Dr. John M. Carroll, Associate Professor of Computer Science, University of Western Ontario, London, Ontario; Dr. J. F. Hart, Head, Computer Science Department, University of Western Ontario, London, Ontario; Dr. E. L. Holmes, Associate Dean, Faculty of Engineering, University of Waterloo, Waterloo, Ontario; Dr. H. I. Schiff, Dean, Faculty of Science, York University, Downsview, Toronto, Ontario, Dr. Paul B. Hagen, Dean, Faculty of Graduate Studies, University of Ottawa, Ottawa, Ontario; Dr. D. W. Slater, Dean of the School of Graduate Studies, Queens University, Kingston, Ontario; Dr. G. E. Connell, Chairman, Department of Bio-chemistry, University of Toronto, Toronto, Ontario; Dr. A. N. Sherbourne, Dean, Faculty of Engineering, University of Waterloo, Waterloo, Ontario; Dr. J. S. Riordon, Faculty of Engineering, Carleton University, Ottawa, Ontario; and Dr. W. B. Rice, Chairman, Graduate Studies, Engineering Sciences Division, Queen's University, Kingston, Ontario.

APPENDICES:

No. 70—Brief submitted by the Faculty of Science, York University. No. 71—Brief submitted by Dr. John Hart, Dean of Science, Lakehead University. No. 72—Brief submitted by the University of Waterloo. No. 73—Brief submitted by the University of Toronto. No. 74—Brief submitted by the Saint Paul University. No. 75—Brief submitted by the Department of Physiology, Queen's University. No. 76—Brief submitted by John C. Robertson, Department of Religion, McMaster University. No. 77—Brief submitted by Laurentian University. No. 78—Brief submitted by the Research Advisory Board, University of Guelph. No. 79—Brief submitted by Division 11, Faculty of Arts, Carleton University. No. 80—Brief submitted by the Department of Computer Science, University of Western Ontario. No. 81—Brief submitted by the Faculty of Engineering, Carleton University.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

“With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, May 28th, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Blois, Cameron, Carter, Grosart, Haig, Hays, Kinnear, Lang, Robichaud and Yuzyk. (11).

In attendance: Philip J. Pocock, Director of Research (Physical Science).

The following witnesses were heard:

Dr. B. M. Millman, Chairman of the Committee on Graduate Studies and Research,

Brock University, St. Catharines, Ontario;

Dr. G. D. Cormack, Associate Professor, Faculty of Engineering
Carleton University, Ottawa, Ontario;

Dr. John Hart, Dean of Science, Lakehead University,
Port Arthur, Ontario;

Dr. G. A. Harrower, Vice-Principal (Academic)
Queens University, Kingston, Ontario;

Rev. Dr. Marcel Patry, O.M.I.
Rector, St. Paul University, Ottawa, Ontario;

Dr. G. de B. Robinson, Vice-President, (Research),
University of Toronto, Toronto, Ontario;

Dr. John M. Carroll, Associate Professor of Computer Science,
University of Western Ontario, London, Ontario;

Dr. J. F. Hart, Head, Computer Science Department,
University of Western Ontario, London, Ontario;

Dr. E. L. Holmes, Associate Dean, Faculty of Engineering,
University of Waterloo, Waterloo, Ontario;

Dr. H. I. Schiff, Dean,
Faculty of Science,
York University, Downsview, Toronto, Ontario;

Dr. Paul B. Hagen,
Dean, Faculty of Graduate Studies,
University of Ottawa, Ottawa, Ontario;

Dr. D. W. Slater,
Dean of the School of Graduate Studies,
Queens University, Kingston, Ontario;

Dr. G. E. Connell, Chairman,
Department of Bio-chemistry,
University of Toronto, Toronto, Ontario;

Dr. A. N. Sherbourne, Dean, Faculty of Engineering,
University of Waterloo, Waterloo, Ontario;
Dr. M. Chagnon, Vice-Rector (Academic Affairs),
University of Ottawa, Ottawa, Ontario;
Dr. J. S. Riordon, Faculty of Engineering,
Carleton University, Ottawa, Ontario;
Dr. W. B. Rice, Chairman,
Graduate Studies, Engineering Sciences Division,
Queen's University, Kingston, Ontario

(A *curriculum vitae* of each witness follows these minutes)

The following are printed as appendices:

- No. 70—Brief submitted by the Faculty of Science, York University,
Downsview, Toronto, Ontario;
No. 71—Brief submitted by Dr. John Hart, Dean of Science, Lakehead
University, Port Arthur, Ontario;
No. 72—Brief submitted by the University of Waterloo, Waterloo, Ontario;
No. 73—Brief submitted by the University of Toronto, Toronto, Ontario;
No. 74—Brief submitted by Saint Paul University, Ottawa, Ontario;
No. 75—Brief submitted by the Department of Physiology, Queens Uni-
versity, Kingston, Ontario;
No. 76—Brief submitted by John C. Robertson, Department of Religion,
McMaster University, Hamilton, Ontario;
No. 77—Brief submitted by Laurentian University, Sudbury, Ontario;
No. 78—Brief submitted by the Research Advisory Board, University of
Guelph, Guelph, Ontario;
No. 79—Brief submitted by Division II, Faculty of Arts, Carleton Uni-
versity, Ottawa, Ontario;
No. 80—Brief submitted by the Department of Computer Science, Uni-
versity of Western Ontario, London, Ontario; and
No. 81—Brief submitted by the Faculty of Engineering, Carleton Univer-
sity, Ottawa, Ontario;

At 6.00 p.m. the Committee adjourned to the call of the Chairman

ATTEST:

Patrick J. Savoie,
Clerk of the Committee

CURRICULUM VITAE

USA

Carroll, John M. Education: Bachelor's in Industrial Engineering (with highest honours) Lehigh University, Bethlehem, Pa. (1950). Master's in Physics, Hofstra University, Hempstead, N.Y. (1955). Doctorate in Industrial Engineering and Operations Research, New York University, New York, N.Y. (1968). Experience: July 1968 to present, Associate Professor of Computer Science, the University of Western Ontario, London, Ontario; Sept. 1964 to July 1968, Associate Professor of Industrial Engineering, Lehigh University, Bethlehem, Pa.; Feb. 1952 to Sept. 1964, Editorial Staff, *Electronics* magazine, McGraw-Hill Inc., New York, N.Y., Managing Editor from 1957 to 1964; Aug. 1950 to Feb. 1952, Electronics Officer, U.S. Navy; Oct. 1947 to Sept. 1948, Senior Radio Engineering Aide, U.S. National Bureau of Standards, Washington, D.C.; Aug. 1944 to Oct. 1947, Electronics Technician, U.S. Navy. Publications: 14 books and about 40 articles including: "The Standard Handbook for Electrical Engineers" (McGraw-Hill, 1968)—Associate Editor; author of section on "Electronic Data Processing". "Characteristics of Modern Production" (Alexander Hamilton Institute 1969). "Careers and Opportunities in Electronics" (E.P. Dutton Co., 1967). "Careers and Opportunities in Computer Science" (E.P. Dutton Co., 1962). Research interests are in information systems design including automatic indexing, on-line data collection and analysis, and computer-controlled product verification.

Chagnon, Maurice—Born: Ottawa, December 4, 1919. Studies: Primary: Saint-Charles, Ottawa. Secondary: University of Ottawa High School. University: University of Ottawa, Faculty of Arts, Faculty of Philosophy, Faculty of Psychology and Education. Columbia University, New York: Research Scholarship—Royal Society of Canada. Academic Degrees: Bachelor of Arts, Bachelor of Philosophy, Licentiate in Philosophy, Master of Arts, Doctor in Philosophy (Psychology). Positions held: Teaching: Lecturer, Faculty of Arts (University of Ottawa); Lecturer, Faculty of Philosophy (U.O.); Lecturer, Faculty of Medicine (U.O.); Lecturer, School of Social Service (U.O.); Full Professor, Faculty of Psychology and Education; Director of Research Seminars in Psychology and Education. Guidance and Counselling: Technician and co-founder of the University of Ottawa Guidance Service (1942); Consultant-Director and founder of the Richelieu Guidance Centre of the Separate School Board of Ottawa (1951-1965). Research: Technical consultant, Research Branch, Department of Labour (1965). Present Position: Vice-Rector, Academic Affairs. Publications and Research: Two manuals on Ottawa-Wechsler Test; Six articles on Professional and Educational Guidance; 34 papers presented to scientific associations; direction of 66 research projects. Other functions: Association canadienne française d'Ontario: Member executive Committee (1963-65); Member of Committee on Education (1964-66); Chairman of the Committee of Social Action of the Diocese of Ottawa; Member of the Subcommittee on Research and Planning of the Committee of Presidents of Ontario; Member of the Board of Governors of the Institute of Pastoral Psychiatry; Member of the Board of Governors of the Ontario Institute for Studies in Education.

Connell, George E. Place of birth: Saskatoon, Saskatchewan. Date of birth: June 20, 1930. Degrees: B.A., University of Toronto, 1951; Ph.D., University of Toronto, 1955. Posts held: Postdoctoral fellow, N.R.C. Ottawa, 1955-56; Postdoctoral Medical Research Fellow National Academy of Sciences held at New York, 1956-57; University of Toronto, Assistant Professor, Department of Biochemistry, 1957-62; University of Toronto, Associate Professor, Department of Biochemistry, 1962-65. University of Toronto, Professor and Chairman, Department of Biochemistry, 1965-70.

Cormack, George D. Born Alberta, September 11, 1933; married; three children. Attended schools in Calgary and in Victoria, B.C. obtained B.A.Sc. (engineering physics) from U.B.C. in 1955. Awarded English Electric Fellowship to study nuclear reactor design in Great Britain (1955-1957). 1957-1959, Project engineer with Computing Devices of Canada Ltd. in Ottawa, Quebec City and Camden, N.J. 1959-1962, M.Sc. and Ph.D. from U.B.C. in physics for electromagnetic shock tube research. Awarded B.C. Telephone Co. Scholarship, NRC Fellowship, and NATO Postdoctoral Fellowship, the latter held at plasma physics research institutes in Munich and Stockholm during 1962-1964. 1964-present, Member of the Faculty of Engineering, Carleton University, Ottawa. Author of about 20 technical papers on plasmas, systems engineering and instrumentation. Acted as consultant on plasmas to NRC and to the Space Science Division of Computing Devices of Canada. Presently consultant on transmission lines to the Research and Development Laboratories of Northern Electric Co. Ltd. and Associate Professor of Engineering at Carleton University, where major concern is with advanced techniques for energy conversion.

Hagen, Paul Beo. B. February 15, 1920 in Sydney, N.S.W., Australia. Nationality: Canadian. Marital status: married, 2 children. Degree: Graduate in Medicine, University of Sydney, 1945. Positions held: Intern, Balmain Hospital, Sydney, N.S.W., Australia, 1945. Medical Officer, N.S.W. Health Department; also Departmental Demonstrator in Biochemistry, University of Sydney and Lecturer in Physiological Chemistry, Sydney Technical College, 1946-48. Lecturer in Physiology, University of Sydney, 1948-50. Senior Lecturer in Physiology, University of Sydney; also Supervisor of Postgraduate Teaching in Physiology (including Biochemistry and Pharmacology) for the Postgraduate Committee in Medicine of the University of Sydney, 1950-51. Senior Lecturer in Physiology, University of Queensland; also examiner for Postgraduate Medical Degrees and Diplomas, University of Queensland, 1951-52. C. J. Martin Fellow in Medical Research, Department of Pharmacology, University of Oxford, 1952-54. Tutor in Biochemistry, Worcester College, 1953-54. Assistant Professor, Department of Pharmacology, Yale University, 1954-56. James Hudson Brown Fellow, 1954-55. Winner of Lederle Faculty Award, 1956. Assistant Professor, Department of Pharmacology, Harvard Medical School, Boston, Massachusetts, U.S.A., 1956-59; also Director NIH graduate training grant program in Pharmacology, Harvard Medical School, 1957-59. Professor and Head of the Department of Biochemistry, University of Manitoba, Winnipeg, Canada, 1959-64. Professor and Head of the Department of Biochemistry, Queen's University, Kingston, Ontario, Canada, 1964-67. Scientific Officer, Medical Research Council (N.R.C. Director), Professor of Biochemistry, Queen's University, 1967-68. Present position: Dean of the Faculty of Graduate Studies, University of Ottawa, Ottawa, Ontario, Canada, 1969. Other activities: Elected Fellow of Chemical Institute of Canada, 1962. Member of Medical Research Advisory Board of the Muscular

Dystrophy Association of Canada, 1960-69. Member of Sub-committee for Biochemistry of the Medical Research Council (Canada), 1962-66. Vice-Chairman of Biochemistry Division, Chemical Institute of Canada, 1962-63. Chairman of Biochemistry Division, Chemical Institute of Canada, 1963-64. Member of Council of Canadian Biochemical Society, 1963-66. Member of Metabolism Committee of Medical Research Council (Canada), 1966-67. Vice-Chairman of the Medical Research Council (Canada), 1967. Recipient of Centennial Medal of Government of Canada, 1968. Member of the Editorial Boards of: *Journal of Pharmacology and Experimental Therapeutics*, 1960-64. *Biochemical Pharmacology*, 1961-66. *Canadian Journal of Biochemistry*, 1964-67. Society memberships: Chemical Institute of Canada; Canadian Biochemical Society; American Chemical Society; American Society for Pharmacology and Experimental Therapeutics; American Association for Advancement of Science; Biochemical Society (Great Britain); British Pharmacological Society; Physiological Society (Great Britain).

Harrower, G. A. A native of Flesherton, Ontario, Dr. Harrower obtained his high school education in Englehart, Ontario, and took undergraduate studies in mathematics and physics at the University of Western Ontario. He graduated in 1949, with a B.Sc., and the university's gold medal in physics. His post-graduate work was done at McGill University, where he was awarded a M.Sc. degree and, in 1952, the degree of Doctor of Philosophy. From 1952 until his appointment to Queen's University in 1955, Dr. Harrower was with the staff of the Bell Telephone Laboratories in Murray Hill, New Jersey. Prior to Dr. Harrower's appointment as Dean of the Faculty of Arts and Science, in 1964, he served as Assistant Dean from 1962 to 1964, and was as well Associate Professor of Physics, teaching in both the Faculty of Arts and Science and the Faculty of Applied Science. In 1969, he was appointed Vice-Principal (Academic). During the spring and Summer of 1969, Dr. Harrower will complete work on the Principal's Committee on Teaching and Learning, and then, at the request of the Principal, will visit a number of universities in Europe and elsewhere to study current developments in the university world. His major academic interest as a professor at Queen's was radio-astronomy, and he was instrumental in establishing the radio-astronomy laboratory at Westbrook, near Kingston. He also designed the observatory for Ellis Hall. During the autumn of 1958, Dr. Harrower was chosen as one of 22 scientists who represented Canada at the conference in Moscow of the International Astronomical Union, held in connection with the International Geophysical Year. Since that time he has attended major international scientific meetings in London, Paris, Tokyo, Washington, San Francisco, Munich, Corfu and Prague.

Hart, John. Born: June 11, 1920, Croydon, England. Married: 3 children. Lakehead University, Dean of Science, 1965; Brock University, Director of Science Studies, 1964-1965; Carleton University, Chairman, Department of Physics, 1957-1964; The National Research Council of Canada, Electricity Section, 1953-1957; The Royal Institution of Great Britain, 1950-1953; University College, London, 1946-1950; Royal Naval Volunteer Reserve, Lieutenant, Communications, 1939-1946; University Degrees: B.Sc. (Special, Physics) (London), 1950; Ph.D. (London), 1953. Learned Societies: Fellow of the Institute of Physics; Senior Member of the Institute of Electrical and Electronics Engineers; Member of the American Institute of Physics; Member of the American Association of Physics Teachers; Member of the Canadian Association of Physics. Activities—Current: Chairman NEMA/IEEE, Education Committee

of Electrical Insulation Conference; Member, Board of Governors, Confederation College; Member, CSA Committee on Electrical Insulation; Technical Consultant, U.S. National Research Council Conference on Electrical Insulation. Activities—Past: Chairman, N.R.C. Committee on Electrical Insulation; Chairman, Science Fairs Committee of Canadian Association of Physicists; Chairman, Lectures Committee of Canadian Association of Physicists; Chairman, CSA, Committee on Electrical Insulation; Member of Council of Canadian Association of Physicists; Member of Industrial Physics Committee of Canadian Association of Physicists; Member of Technicians Committee of Canadian Association of Physicists; Executive Member, U.S. N.R.C. Conference on Electrical Insulation; Member of International Electrotechnical Committees, TC.15 and TC.28.

Hart, John F. Head, Computer Science Department, The University of Western Ontario. Education: Bachelor's in Physics, University of Toronto 1946; Master's in Physics, University of Toronto 1948; Doctorate in Physics, University of Toronto 1953. Experience: 1953 to 1959, Assistant Research Officer, Applied Physics, N.R.C. 1959 to 1960, Secretary, Computer Committee, Physics Dept., University of Western Ontario; 1960 to present, Head, Computer Science Department, University of Western Ontario. Other: N.R.C. Grant Selection Committee for Computers 1962-1965. Publications: J. F. Hart & G. Herzberg: "Twenty-Parameter Eigenfunctions and Energy—Values of the 2^3S States of He and He-like Ions", *Physik* 171, 1963 J. F. Hart & W. Fraser: "Near-Minimax Polynomial Approximations and Partitioning of Intervals", *Comm. ACM*, 7, 1964, pp. 486-489. W.J. Cody, W. Fraser, and J. F. Hart: "Rational Chebyshev Approximations Using Linear Equations", *Numerische Mathematik*, 1968, (accepted for publication late 1968). J. F. Hart, S. Takasu: "Systems and Computer Science", University of Toronto Press, Toronto, 1968. J. F. Hart et al: "Computer Approximations". *SI Applied Math Series*, John Wiley & Sons, New York, 1968.

Holmes, Ernest Leonard. Born: Kent, England, January 16, 1933. Marrier with four children. Education: (1) Primary & Secondary Schooling in Kent, England; (2) University Education: (i) University of Bristol, B.Sc. Physics 1955; (ii) University of Toronto, M.A.Sc. Metallurgical Engineering 1956; Ph.D. Metallurgical Engineering 1959. Posts held: (i) 1966 to present, Association Dean, Faculty of Engineering, University of Waterloo; Professor of Mechanical Engineering University of Waterloo; (2) 1964-6 Administrative Officer, Faculty of Engineering, University of Waterloo; Tutor, University Village Residence; (3) 1962-4 Assistant Secretary, Careers and Appointments Board, University of Nottingham, England; (4) 1960-2 Special Lecturer and Research Associate in Physical Metallurgy, University of Toronto, Canada; (5) 1959-60 Assistant Lecturer in Physics, Medway College of Technology, Kent, England; (6) 1956-7 Metallurgist, Orenda Engines Limited, (Hawker-Siddeley Group), Malton, Ontario, Canada; Evening Class Lecturer in Physical Metallurgy, Ryerson Institute of Technology, Toronto. Publications: Ten publications in various scientific journals in addition to various general articles. Current society memberships: (i) Institute of Physics and the Physical Society. A.Inst.P.; (ii) Association of Professional Engineers of Ontario. P. Eng. Other pertinent activities: (i) Conestoga College of Applied Arts and Technology, Member of Board of Governors. Languages: Some French. Present Interests are related to the development of national science policies and in particular the role of the universities in such development. Publications: (a) Scientific Papers (Co-authored): 1. Growth

Conditions for the Stability of a Cellular Solid-Liquid Interface, *Can. J. Physics* 1957, 35, p. 1223. 2. Grain Growth in Zone-Refined Tin, *Acta Met.* 1959, 7, p. 411. 3. Effects of Lead, Bismuth, Silver and Antimony on Grain Growth in Zone-Refined Tin, *J. Inst. Metals* 1960, 88, p. 468. 4. Normal Grain-Growth in Zone-Refined High-Purity Metals, *Can. J. Physics* 1959, 37, p. 496. 5. Comparisons Between Free Energies of Activation for Grain Growth, Grain Boundary Self-Diffusion and Liquid Self-Diffusion, *Can. J. Physics* 1960, 37, p. 899. 6. Effect of Solute Atoms on Grain Boundary Migration in Pure Metals, *Can. J. Physics* 1961, 39, p. 1223. 7. Effect of Lead and Bismuth on Grain Growth in Zone-Refined Tin, *Transactions A.I.M.E.* 1962, 224, p. 945. 8. Effect of Solute on Grain Growth in a Pure Metal etc., *Can. Met. Quarterly* 1962, 1, 2, p. 187. 9. Grain Growth in Zone-Refined Zinc, *Can. Met. Quarterly* 1963 2, p. 177. 10. Concerning the Distribution Coefficient of Gold in Lead, *Can. J. Physics* 39, 945, 1961. (b) General Articles: 1. Wanted: A New Unit on a Canadian Campus to Study Science Policy (Science Forum—August 1968). 2. Cooperative Engineering Education at the University of Waterloo (Accepted for Publication in 1969 in the *International Journal of Electrical Engineering Education*). 3. Importance of the Orientation of Research to the Solution of Problems Related to the Needs of the Country and Region—Some Views from the Canadian Scene. (with A. N. Sherbourne) Presented at the 3rd Pan American Meeting on Post-Graduate Engineering in Rio de Janeiro, December 1968 (To be published). 4. Research Cooperation Between Industry, Universities and Government, to be published in "Canadian Business". 5. Comment on the "Canadian Organization for Joint Research"—requested by editor of Science Forum, (published 1969). 6. Industry/University Collaboration, to be published in "Advance" October 1969.

Millman, Barry Mackenzie. Born: October 17, 1934, Toronto, Ontario. Married Olive Marilyn Gardiner July 1959. Children: Lynne Mackenzie, born December 1960; Christine Gardiner, born September 1962; Suzanne Theresa, born February 1965. Education: 1947-53, Glebe Collegiate Institute, Ottawa, Ontario; 1953-57, Carleton University, Ottawa, Ontario, B.Sc. degree with first class honours in Physics awarded Governor General's Medal; 1957-61, King's College, University of London (England) Ph.D. degree (1963) in Biophysics (Thesis title: The Mechanical Properties of Molluscan Smooth Muscle). Fellowships: 1957-60, Imperial Oil Graduate Research Fellowship; 1960-61 National Research Council of Canada Special Scholarship. Academic Positions: 1961-1966, Member of Scientific Staff: Medical Research Council Biophysics Research Unit, King's College, University of London (England); 1966-1967, Associate Professor and Head, Department of Biological Sciences, Brock University, St. Catharines, Ontario; 1967, Professor and Chairman, Department of Biological Sciences, Brock University, St. Catharines, Ontario; 1966-69, Member of University Senate and Chairman of the University Committee on Graduate Studies and Research; University Representative on the Ontario Council on Graduate Studies. Membership in Professional Societies: American Biophysical

Society; British Biophysical Society; Canadian Society for Cell Biology (Treasurer 1968-); Physiological Society of London (Associate Member). Publications: Lowy, J. & Millman, B. M. (1959), Active state in *Mytilus* muscle, *J. Physiol.* 146, 32-33P. Lowy, J. & Millman, B. M. (1959), Contraction and relaxation in smooth muscles of lamellibranch molluscs, *Nature, London.* 183, 1730-1731. Lowy, J. & Millman, B. M. (1959), Tonic and phasic responses in the anterior byssus retractor muscle (ABRM) of *Mytilus*, *J. Physiol.* 149, 68-69P. Lowy, J. & Millman, B. M. (1962), Mechanical properties of smooth muscles of cephalopod molluscs, *J. Physiol.* 160, 353-363. Millman, B. M. & Colvin, J. R. (1961), The formation of cellulose microfibrils by *Acetobacter xylinum* in agar surfaces, *Can. J. Microbiol.* 7, 338-387. Lowy, J. & Millman, B. M. (1963), The contractile mechanism of the anterior byssus retractor muscle of *Mytilus edulis*, *Phil. Trans. B.* 246, 105-148. Millman, B. M. (1963), Relaxation in the translucent adductor muscle of the oyster *Crassostrea angulata*, *J. Physiol.* 169, 87-88P. Millman, B. M. (1964), Contraction in the opaque part of the adductor muscle of the oyster (*Crassostrea angulata*), *J. Physiol.* 173, 233-262. Lowy, J., Millman, B. M. & Hanson, J. (1964), Structure and function in smooth tonic muscles of lamellibranch molluscs, *Proc. Roy. Soc. B.* 160, 525-536. Millman, B. M. & Elliott, G. F. (1965), X-ray diffraction from contracting molluscan muscle, *Nature, London.* 206, 824-825. Elliott, G. F., Lowy, J. & Millman, B. M. (1965), X-ray diffraction from living striated muscle during contraction, *Nature, London.* 206, 1357-1358. Millman, B. M. (1966), Apparatus for simultaneous recording of length and tension changes in muscle, *J. Physiol.* 185, 12-14P. Lowy, J., Hanson, J., Elliott, G. F., Millman, B. M. & McDonough, M. W. (1965), The design of contractile systems, In: *Principles of Biomolecular Organization*, Symposium of the C.I.B.A. Foundation, 1966, pp. 229-253, Ed. G. E. W. Wolstenholme & M. O'Connor: J. & A. Churchill Ltd., London. Millman, B. M., Elliott, G. F. & Lowy, J. (1967), Axial Period of Actin Filaments: X-ray Diffraction Studies, *Nature, London.* 213, 356-358. Millman, B. M. (1967), Muscle (Biophysics) X-ray diffraction analysis, *McGraw-Hill Yearbook of Science and Technology*, pp. 256-258. Elliott, G. F., Lowy, J. & Millman, B. M. (1967), Low angle X-ray diffraction studies of living striated muscle during contraction, *J. Mol. Biol.* 25, 31-46. Millman, B. M. (1967), Mechanisms of Contraction in Molluscan Muscle. *Amer. Zool.* 7, 583-591.

Patry, Rev. Dr. Marcel, O.M.I. Birth: At Beaumont, Que., January 31, 1923. Studies: University of Ottawa: 1945, B.A., 1946, L.Ph., 1947, M.A., 1949, Ph.D. (Esthetics), 1950, L.Th., 1955, D.Ph. (Logic). Teaching: Professor at the Faculty of Philosophy of the University of Ottawa, from 1960 to 1968. Secretary of the Faculty of Philosophy of the University of Ottawa, from 1956 to 1968. Since August 1968, rector of Saint Paul University, Ottawa, Canada. Publications: *Delineatio cursus logicae*, 1955: *L'objet et les limites de la logique chez saint Thomas*. Mimeographed, Faculty of Philosophy, University of Ottawa, 1955. *Réflexions sur les lois de l'intelligence*. Fides, Montreal, 1965, 143 pages.

Rice, William Bothwell. Born at Montreal, June 10, 1918. Education: The High School of Montreal, Graduation 1935; McGill University, B.Eng. (Mech.) 1944; M.Eng. (Mech) 1956; Sir George Williams University, B.Sc. 1950; École Polytechnique, l'Université de Montréal D ès Sc. App (Magnum cum laude) 1959. Awards: Commissioners' Scholarship 1932, 1933, 1934; The Workman Studentship in Mechanical Engineering 1940-1944; Northern Electric Fellowship 1958-59; First Canadian elected to the International Institution for Production; Engineering Research (CIRP) 1964. Employment: 1935-1940, Blueprint

operator and draughtsman Northern Electric Co., Ltd.; Summer 1941-43, Junior Toolmaker Northern Electric Company Ltd.; 1944-1946, Active service Royal Canadian Navy, Rank at discharge: Lieut (E); 1946-47, Junior Engineer, Engineer of Manufacture, Northern Electric Company; 1947-50, Lecturer and Assistant Professor in Mechanical Engineering McGill University. Summers: 1948, Design Engineer, Dominion Oilcloth & Linoleum Company; 1949, Designer, Canadian Industries Ltd.; 1950, Machine designer, Northern Electric Company; 1950, date, Associate Professor and Professor in Mechanical Engineering Queen's University. Summers: 1951, 52, 53, 56, Engineer, Canadian Industries Ltd. and Dupont Company of Canada Ltd.; 1955, Consultant, Pulp and Paper Research Institute. Technical Societies: Permanent president Engineering 1944 McGill; Engineering Institute of Canada, Chairman Kingston Branch, 1961-62; Councillor, 1963-66, Vice President Region V, 1966-68; American Society of Mechanical Engineers; American Society of Tool and Manufacturing Engineers; Canadian Institute of Mining and Metallurgy; American Society for Engineering Education; Association of Professional Engineers of Ontario. Publications: "Metal Cutting—A Research Problem", by W. B. Rice, Trans. E.I.C. Vol. 2 No. 4, pages 149-152. "The Formation of Continuous Chip in Metal Cutting", by W. B. Rice, E.I.C. Journal Vol. 44, No. 2, pages 41-45. "Photoelastic Determination of Cutting Tool Stresses", by W. B. Rice, R. Salmon, and W. D. Syniuta, Tool Trans. E.I.C. Vol. 4 No. 1, 1960. "Force Variation During the Formation of Continuous Segmented Chips in Metal Cutting", by W. B. Rice, R. Salmon and L. T. Russell, E.I.C. Journal Vol. 45 No. 5, pages 59-62. "Some Effects of Microstructure on Chip Formation", by W. B. Rice, R. Salmon and S. N. Chopra, A.S.M.E. Paper No. 62-Prod-7. "Determination of the Pattern of Isotherms in a Metal Cutting Tool Using Infra Red Photography", by R. Salmon, W. B. Rice and P. S. Chandrasekaran, E.I.C. Journal, Paper No: EIC-63 Mech. 24; Vol. 1 No. 29, December 1963. "Some Effects of Cutting Fluids on Chip Formation in Metal Cutting", by H. S. Rama Iyengar, R. Salmon and W. B. Rice, Trans. A.S.M.E. Journal of Engineering for Industry. Series B Vol. 17 No. 1 pages 36-38. "Effects of Cooling and Heating Workpiece and Tool on Chip Formation in Metal Cutting", by W. B. Rice, R. Salmon and A. G. Advani, International Journal Vol. 6. "Cutting Fluid Research", by C. S. Sharma, W. B. Rice and R. Salmon, Lubrication Engineering, Vol. 23 No. 12, pages 481-486. "Isothermal Patterns in Cutting Tools of Different Face Length", Annals of the CIRP, Vol. XVI, 1968, pp. 217-222, (with R. Salmon, and G. D. M. McCulloch). "A Study of Chip Formation Using Paraffin Wax to Simulate Metals", Transactions Engineering Institute of Canada, bound with Journal EIC Vol. 51, Vol. 11, No. B-2. "Research in Hydrostatic Extrusion", Canadian Institute of Mining and Metallurgy Canadian Conference of Metallurgy Canadian Conference of Metallurgists, 1966, (with H. S. R. Iyengar). "Fluid-film Lubrication in Hydrostatic Extrusion", International Institution for Production Engineering Research (CIRP) General Assembly Paper 1968, (to be published in Annals of CIRP) (with H. S. R. Iyengar). Special Universities Activities: Commanding Officer 103 University RCAF with rank of Wing Commander (Lt-Col) 1960 to date; Chairman, Graduate Studies Engineering Sciences Division 1964 to date.

Riordon, J. S. received the degree of B.Eng. in Electrical Engineering from McGill University in 1957 and the degree of M.Eng. in 1961. Between 1957 and 1963 he was employed by the Radio and Electrical Engineering Division of the National Research Council, Ottawa, where he worked in the areas of radar

signal detection, transistor circuit design, and narrow band image transmission. In 1963, on leave of absence from NRC, he began studies in Automatic Control at the Imperial College of Science and Technology, London, obtaining the Ph.D. degree in 1967. In 1968 he joined the Faculty of Engineering at Carleton University; his current research interest is in the field of adaptive control. Dr. Riordon is a member of the Association of Professional Engineers of the Province of Ontario, and of the Institute of Electrical and Electronic Engineers.

Robinson, G. de B., Born: Toronto, 1906 B.A.: University of Toronto, 1927. PhD.: Cambridge University, 1931. Department of Mathematics, University of Toronto: 1931. National Research Council: 1941-45. Visiting Professor, Michigan State University: 1952-53; visiting Professor, University of British Columbia: 1963; visiting Professor, University of Canterbury, Christchurch, N.Z.: 1968. Vice-President (Research), University of Toronto: 1965. F.R.S.C.: 1944. President, Section III: 1959-60; 1961-62. MBE: 1946. Managing Editor, Canadian Journal of Mathematics: 1949. Publications: 3 books and numerous papers. President, Can. Math. Congress 1953-57.

Schiff, Harold Irvin. Personal Data: Born: Kitchener, Ontario, June 24, 1923. Married, 2 children. Academic Qualifications: B.A., 1945, University of Toronto, Honours Physics and Chemistry (First in First Class Honours); M.A., 1946, University of Toronto, Physical Chemistry; Ph.D., 1948, University of Toronto, Electrochemistry Research Director: Dr. A. R. Gordon. Employment: 1948-50, N.R.C. Fellow with Dr. E. W. R. Steacie—Gas Phase Kinetics; 1950-65, Assistant, Associate & Full Professor of Chemistry at McGill University; 1959-60, Nuffield Fellow at Cambridge, England; 1965, Professor, Chairman of Department of Chemistry and Dean of Science, York University; 1968, Professor, Department of Chemistry, Dean of the Faculty of Science, York University. Scholarships & Fellowships: Undergraduate: 1941, Edward Blake Entrance Scholarship in Chemistry and Physics; 1942, Class of 1930 Scholarship; 1943, Laughlin Gilchrist Scholarships. Graduate: 1946-48, National Research Council Predoctoral Fellowship. Associations: Fellow of the Chemical Institute of Canada; A.A.A.S.; Sigma Xi; Canadian Association of University Teachers. Offices Held Outside the University: Associate Editor, Journal of Chemical Physics; Editorial Board, Planetary and Space Science; Editorial Board, Journal of Chemical Kinetics; Associate Committee of the National Research Council on Space Research; Executive Committee on the Mass Spectrometry Section of the Association for the Standard and Testing of Materials; Chairman, Physical Measurements Subcommittee of the International Association on Geomagnetism and Aeronomy; Steering Committee of the International Congress of Atomic and Electron Collisions; Defence Research Board Geophysical Research Panel. Previous Offices and Consultantships; 1953-54, Chairman, Montreal Section, Chemical Institute of Canada; 1962-63, Chairman, Chemical Education Division, Chemical Institute of Canada; Geophysics Corporation of America; Ballistics Research Laboratories, Aberdeen Proving Ground, Maryland; Canadian Armaments Research and Development Establishment; National Bureau of Standards, Boulder, Colorado; Environment Science Service Administration, Boulder, Colorado. Awards: 1965, Best Scientific Paper of the Year Award, Boulder Laboratories—N.B. S and E.S.S.A.; 1967, Best Paper in Five Year Period, Boulder Laboratories—N.B.S. and R.E.S.A. 1968, Scientist Award, Boulder Branch of R.E.S.A.

List of Publications: 1. Safety Control Device for Use with Glass Cloth Heating Mantles, Harold I. Schiff, *Analytical Chemistry* 19, 503 (1947). 2. The Conductance of Sodium and Potassium Chlorides in 50-Mole Percent Methanol-Water Mixtures, H. I. Schiff and A. R. Gordon, *J. Chem. Phys.* 16, 336 (1948). 3. "Vapor Snakes" in Cyclohexane, M. K. Phibbs and H. I. Schiff, *J. Chem. Phys.* 17, 843 (1949). 4. The Reactions of H and D Atoms with Cyclic and Paraffin Hydrocarbons, H. I. Schiff and E. W. R. Steacie, *Can. J. Chem.* 29, 1 (1951). 5. Equivalent and Ionic Conductances for Sodium and Potassium Chlorides in Anhydrous Methanol at 25°C., J. P. Butler, H. I. Schiff and A. R. Gordon, *J. Chem. Phys.* 19, 752 (1951). 6. Reactions with Active Nitrogen, C. A. Winkler and H. I. Schiff, *Disc. Faraday Soc.* 14, 63 (1953). 7. The Use of a Diffusion Cloud Chamber to Characterize Condensation Nuclei, Daphne Schiff, H. I. Schiff and P. R. Gendron, *Can. J. Chem.* 31, 1108 (1953). 8. Mass Spectral Investigation of "Active" Nitrogen, D. S. Jackson and H. I. Schiff, *J. Chem. Phys.* 21, 2233 (1953). 9. Investigations of the "Vapor Snake" Phenomenon, R. Verschingel and H. I. Schiff, *J. Chem. Phys.* 22, 723 (1954). 10. Mass Spectrometric Investigation of Active Nitrogen, D. S. Jackson and H. I. Schiff, *J. Chem. Phys.* 23, 2333 (1955). 11. The C-H Bond Dissociation Energy in Fluoroform, G. O. Pritchard, H. O. Pritchard, H. I. Schiff and A. F. Trotman-Dickenson, *Chemistry and Industry*, 1955, p. 896. 12. Modified Direct Current Conductance Method for General Application, L. Elias and H. I. Schiff, *J. Phys. Chem.* 60, 595 (1956). 13. Mass Spectrometry of Ozone, J. T. Herron and H. I. Schiff, *J. Chem. Phys.* 24, 1266 (1956). 14. The Reactions of Trifluoromethyl Radicals, G. O. Pritchard, H. O. Pritchard, H. I. Schiff and A. F. Trotman-Dickenson, *Trans. Faraday Society*, 52, 849 (1956). 15. The Reaction of Deuterium Atoms with Ethylene, S. Toby and H. I. Schiff, *Can. J. Chem.* 34, 1061 (1956). 16. Mass Spectrometry of Gases Subjected to Electrical Discharge, H. I. Schiff, *Annals of New York Academy of Sciences*, 67, 518 (1957). 17. A Mass Spectrometric Study of Normal Oxygen and Oxygen Subjected to Electrical Discharge, J. T. Herron and H. I. Schiff, *Can. J. Chem.* 36, 1159 (1958). 18. The Use of Rockets to Determine Atmospheric Composition, H. I. Schiff, *Chem. in Canada*, p. 27, February 1959. 19. A Modification of the R.P.D. Method for Measuring Appearance Potentials, G. G. Cloutier and H. I. Schiff, "Advances in Mass Spectrometry", p. 473. (Pergamon Press, London, 1959). 20. The Study of Electrically Discharged O₂ by means of an Isothermal Calorimetric Detector, L. Elias, E. A. Ogryzlo and H. I. Schiff, *Can. J. Chem.* 37, 1680 (1959) (No Longer Available). 21. The Reaction of Oxygen Atoms with NO, E. A. Ogryzlo and H. I. Schiff, *Can. J. Chem.* 37, 1690 (1959). 22. Electron Impact Study of Nitric Oxide Using a Modified Retarding Potential Difference Method, G. G. Cloutier and H. I. Schiff, *J. Chem. Phys.* 31, 793 (1959). 23. Electrically Discharged CO₂ as a Source of Oxygen Atoms, E. A. Ogryzlo and H. I. Schiff, *J. Chem. Phys.* 32, 628 (1960). 24. Recombination of Oxygen Atoms in the Absence of O₂, J. E. Morgan, L. Elias and H. I. Schiff, *J. Chem. Phys.* 33, 930 (1960). 25. Some Atomic Reactions by Absorption Spectroscopy, H. P. Broida, H. I. Schiff and T. M. Sugden, *Nature*, 185, No. 4715, 759 (1960). 26. Absolute Rate Measurements of O-Atom Reactions with Ethylene and with Butane, L. Elias and H. I. Schiff, *Can. J. Chem.* 38, 1657 (1960). 27. Observations on the Chemiluminescent Reaction of Nitric Oxide with Atomic Oxygen, H. P. Broida, H. I. Schiff and T. M. Sugden, *Trans. Faraday Society*, 57, 259 (1961). 28. The Reaction of Oxygen Atoms with Carbon Tetrachloride, A. Y-M Ung and H. I. Schiff, *Can. J. Chem.* 40, 486 (1962). 29. Absolute Rate Constant for Light Emission of the Air Afterglow Reaction for the Wavelength Region, 3875-6200 Å., A. Fontijn and H. I. Schiff,

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THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, May 28, 1969

The Special Committee of the Senate on Science Policy met this day at 3 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have the honour to receive representatives from the various universities of the Province of Ontario this afternoon. We will proceed as we have done since yesterday afternoon. First of all we will ask the spokesman for each university to make a brief statement under the assumption that if a brief has been sent to the members of the committee it has been read by them.

We will start with Dr. Millman from Brock University.

Dr. B. M. Millman (*Chairman of the Committee on Graduate Studies and Research, Brock University, St. Catharines*): Mr. Chairman and honourable senators, like many of the other universities we have not submitted a written brief. We have submitted one to the Macdonald Committee setting out our views on the question of research support.

The Chairman: I assume some of your views have been distorted in the Macdonald Report?

Dr. Millman: There are two particular aspects of research support relating to developing universities on which I would like to comment at this time. A number of the points made earlier in the discussion would also apply to our university. Firstly, dealing with research funding for personnel who are not directly involved in graduate studies, I think it is generally acknowledged that research is needed in most areas of the universities by its faculty to provide a suitable undergraduate program. This point has been made previously on several occasions. The funding for such research should certainly be on the basis of

merit, the merit of the researcher and the merit of the project, which is consistent with what is proposed in the Macdonald Report.

There are, however, some problems which arise when one is forced to evaluate the merit of faculty members who are not involved with graduate studies. In the Ontario context, taking the example of a person who is doing research for himself and who receives a research grant of \$10,000. He is carrying out that research on his own and that is the total support he has for that project. If, however, he has two Ph.D. students, under the Ontario Formula System, then the university, not the faculty member, receives approximately \$18,000 in addition, some of which will be available to support the research project in either a direct or indirect manner. Where the faculty member in the university is associated with the graduate program, it is more likely to be productive than where the faculty member is working without a graduate program. If these two men are being compared on the same basis, it is likely that the person from the university without the graduate program will show up poorly by comparison. This will certainly be the case if quantity of research is the criterion used.

Now, this naturally causes some concern, because I think it is clear to all of us that we cannot develop full graduate programs in all 14 universities in Ontario, and certainly not to the Ph.D. level. Therefore we are concerned lest the support for good research people should fall off for this sort of reason. This is where the federal government can help by keeping this type of problem in mind.

The second area where there is a problem is that involving junior faculty members who have not yet established a reputation. NRC does have a policy of support for these people for the first few years which seems to work reasonably well. But here again universities with a small operating budgets find it more difficult to supplement funds available to such staff members through providing technical

assistance, through post-doctoral facilities and libraries etc., than universities which have a large proportion of income derived from graduate studies. Perhaps the best way of helping these people is through general purpose grants such as those given by NRC. One of our recommendations to the Macdonald Commission was that this sort of grant through the university be afforded in the humanities and social sciences where such support is not otherwise available.

We are rather disturbed to see that one of the recommendations of that report was that these grants should be discontinued, and I think we should look at this problem rather carefully particularly in the smaller universities because in my view such grants can play a real role in supporting junior faculty members who do not attract support on the basis of their own merit yet.

The Chairman: It seems to us that since yesterday afternoon everybody is opposed to Toronto.

Dr. Millman: I would not like my remark to be interpreted in that fashion but we are, perhaps, a little suspicious of some of the major universities.

The second aspect of the role of the smaller universities in some studies has to do with the term "centres of excellence." This term is now used a great deal, but it usually seems to imply that these centres of excellence must be large centres. We feel that excellence need not be of necessity associated with largeness, and that there is a role the small university can play in developing small areas of excellence in specialized fields, carefully selected, where they can develop up to the PhD level, highly specialized programs of excellence which we hope could compare with or even surpass those from the larger institutions. One of the areas where this might be particularly important was mentioned this morning by a representative from Loyola, and that is where interdisciplinary studies are involved because in a smaller institution it is easier for diverse departments to co-operate and produce a program that would be difficult to establish in the larger universities.

In conclusion, then, we would like urge the encouragement of research excellence in the smaller universities, particularly in suitable selected areas where they can excel.

The Chairman: Thank you very much. And now the spokesman for Carleton.

Dr. G. D. Cormack, Associate Professor, Carleton University, Ottawa: Honourable senators, I would like to present to you some opinions that form the consensus of the members of the Faculty of Engineering at Carleton University. Our brief which we have submitted to you is only three pages in length, so I suppose I could refer to it as a very brief brief. We have had to omit many topics from it, but this omission does not mean disapproval or disinterest where these topics are concerned. An example of this is the topic raised by the previous speaker about grants to faculty members. We do not disapprove of them simply because we have not mentioned them in our brief. Our brief is concerned with three major topics. These are (1) the interface between people and science, (2) the research institute concept, and (3) the fact that we believe that now is the time for major encouragement for technology and engineering.

These three topics are considered in this order in our brief at approximately one topic per page.

I will expand briefly on these three topics. First, the interface between the average person and science. We in the faculty of engineering are concerned about this very human problem, because we have seen so often that average people feel disinterested in and even alienated by science and technology. We believe that a science policy can assist in making science human-oriented and that it can assist in making humans science-oriented. These two objectives should be sought simultaneously, because it is only then that Canadians in all walks of life will realize the fruits of science. Science produces through technology not only labour-saving devices but also a more comfortable and enjoyable world both during working hours and during leisure hours. A science policy that caters to the applied sciences, which include technology and engineering, will serve the Canadian people well, because it will help to smooth out the interface that exists between humans and science.

Our second topic concerns the proposal that the federal Government seek to set up research institutes in certain well-defined fields of interest. Our brief makes suggestions about funding, about the desirability of interdisciplinary contacts, about the desirability of mobility of employees to and from government, universities and industry—that is, to these institutes—and also about the desirability of these institutes operating distinct from

any existing system in Canada. If the fields of study for these institutes are chosen carefully, we believe that they will substantially pay for themselves because of the resultant decrease in fragmentation of research effort, which we are all aware exists to some extent in our universities today.

Our third topic concerns the stature that engineering and technology enjoy today in Canadian society. The people most involved with production problems, with innovation and with product development are the technologists and engineers. A few figures that reveal a problem that Canada faces today are given in the report entitled, "Foreign Ownership and the Structure of Canadian Industry" prepared by the Task Force on the Structure of Canadian Industry. There it states that, as of a couple of years ago, the number of engineers per 10,000 of population in Canada was seven, whereas Sweden had 22 and the United States 25. A Swedish engineer is not called an engineer until he is the equivalent of a Canadian master's degree student, so these figures are more divergent than they appear on the surface. Surely, this discrepancy bears close scrutiny. An innovative climate can be created by suitable news media attitudes, by education and by a science policy that recognizes the importance of the applied sciences.

Finally, we would like to state that we consider that the Government of Canada should shoulder the responsibility for science policy, as it now does for foreign policy and defence policy. Specifically, the responsibility should not be allocated to a non-elected group such as the National Research Council.

The Chairman: I am sure you will have questions on your last sentence in a few moments. Thank you very much, Dr. Cormack.

Now we go to Dr. Hart, of Lakehead University.

Dr. John Hart, Dean of Science, Lakehead University, Port Arthur: Mr. Chairman and honourable senators, we have taken the liberty of preparing an informal written statement rather than wasting the time of the committee with a rather long, formal statement. The written statement is informal deliberately, because we feel it is sometimes forgotten that science is only one aspect of human activity, and that the personal aspects of science are often neglected. We feel very much that the Macdonald Report can be criticized for its lack of appreciation, at least on the surface, of this fact.

In the statement we make the following points:

First, we believe that the policy of the scientific bodies of all kinds in Canada tends to discriminate in favour of the well-established individual scientists and research groups, and tends to discourage the development of the research talents of all but the most brilliant young scientists, and inhibits the development of research groups in new areas, or in interdisciplinary areas, or in new institutions.

Secondly, we believe that the development of applied science of all kinds is an essential ingredient in the lifeblood of the nation, and we believe that the controlling bodies of science and the industrial community are not exerting themselves to assist applied research which would be of short- or long-term benefit to Canadian industry.

Thirdly, my colleague from Carleton has mentioned the interface between people and science. We believe that there is a desperate lack of understanding of the effects of science and technology, or, indeed, of techniques of all kinds, including business techniques, upon our society. We believe that far more effort should be put into not just the control of the obvious bad effects of our technology, such as the pollution that Senator Haig mentioned this morning, but into the more subtle effects such as the disaffection of our young. We believe that the arrogance of we scientists constitutes a large factor in the turmoil that has developed on university campuses and elsewhere, and we believe that academics and public servants who are interested in this problem should be given far more tangible support. What we refer to here is not the popularization of science or the instruction of the young people in scientific techniques, but a study of the effect of those techniques on the young, primarily, but not excluding the careful study of the present and likely future development of Canadian society in a technical world.

You might ask me for an example, and there happens to be a very simple one developing in north-western Ontario right now. The young people see that Canada has expended several millions of dollars in investigating the ionosphere—and I do not wish to criticize this project; it is a very worthy project run by excellent people. However, in northwestern Ontario the Indian population would like to ask what effect this research is going to have on them, because until a month

ago they had to rely exclusively on the CBC northern service whose antennae are unfortunately beamed in the opposite direction, I believe, and it is only within the past month that the Company of Young Canadians—more power to them—has developed a fleet of transmitters on, I believe, half-ton trucks, and is driving them into Indian communities and is providing them with a service they so desperately need. It seems to me that here is a classic example of the apparent arrogance of our scientists. Thank you, Mr. Chairman.

The Chairman: Now, Dr. Harrower, Dean of the Faculty of Arts and Science, and Vice-Principal (Academic) (elect) from Queen's University. I hope it was not as a result of a general election!

Dr. G. A. Harrower, Dean of the Faculty of Arts and Science, Queen's University, Kingston: No, Mr. Chairman, I think it was a very specific election.

I believe my remarks should be essentially confined to the generalities of the problem rather than attempting to assess those aspects of it we at Queen's share in common with many other speakers. It seems to me the question of science education is only answerable in terms of goals we are attempting to define and, presumably, to achieve. Policy must have some end in view, and I think it goes more or less without saying that what we are really searching for are goals, we hope, of healthy science policy, so that subsequently a healthy state of science in our country will be capable of achievement.

When we talk of the goals of science and scientists, there is often confusion between the goals which individual scientists may legitimately follow and the goals which the society which supports him may have in mind. While I do not necessarily see a conflict, in the sense that the individual works at his subject primarily for the love of it, because of the challenge involved and the sense of personal achievement derived from it, on the other hand, the society which benefits from this in one way or another presumably has in mind other goals having to do with the general welfare of that society, as measured in some reasonable way.

Now, the difficulty here, it seems to me, lies in what is a reasonable way to measure the achievements of science, or of the science policy that brings about these achievements. We are all too prone, I think, to measure the success of any large-scale venture in terms of

such things as the gross national product or some of those other numbers that can be so readily quoted. Thinking of the university context, for example, the university is prone to measure its success in terms of numbers of students graduated, or numbers of papers written by members of staffs, or, as we have been told recently, the number of faculty members who are airborne at any particular moment. These may or may not be criteria by which to measure the programs concerned. I think we have to be very careful that we do not, at the level of our basic assumptions, make mistakes in evaluating science policy as science policy which maximizes some aspect of our economy. It may be good for that reason, or it may not, and it may be good for another and entirely different reason.

To put it in other terms, the goal of our national policies must be the maximization of the welfare of the largest number of people. It seems to me, speaking as a one-time scientist, that scientists are in no sense immune from having individual goals. That is not to say that their individual goals may not be different, as our individual personal goals frequently are. I would like to draw something of a contrast between the natural scientist and the social scientist.

Again, speaking as a one-time natural scientist, I think I am correct in saying that the natural scientist has by far the easiest problems, because he has thrown all of the hard problems out. If you are not entirely persuaded of that then sit down and talk to the sociologist for half a day and listen to the problems he has to deal with.

Natural science is, therefore, a well-structured system of asking simple questions for which there are simple answers. The social scientist faces the more challenging problem of asking complex questions, some of which are not formulated, and of looking for very complex answers which are of significance.

Another difference between the natural and social scientist is that the natural scientist has underlying his work the fabric of the natural universe which serves as a test for all of his ideas, whereas the social scientist lives in an area that is not properly formulated, and he lives in it as it is being formulated.

There is also the fact that the natural scientist at best is inventive in the sense that he is not creating what he studies. He is simply uncovering. Whereas, a social scientist must be creative. He has to create the very substance which he studies.

This difference is sometimes minimized, and I think it is unfortunate that the social scientists sometime ago proposed to call themselves scientists, because I think this is a limitation they could well have avoided.

Policies, then, as formulated for the natural sciences and for the social sciences are inevitably different at the basic level, because of the different natures of the two activities. It would seem to me, to put the matter plainly, that the goal of science, pure and simple—I do not mean “pure” in an exalted sense, but in its simplest sense—is to determine truth, to discover facts, relationships, and so on, with the intention of having these eventually applied to our lives in this particular physical environment.

Science is often confused with technology and engineering, which are equally noble, but fundamentally different. Science asks the basic questions, whereas technology and engineering and many other related activities are attempting to apply answers to the problems which humanity faces. In that sense, then, the social justification for science lies in the application of these principles, and it requires something like a 25-year lead time. You cannot help technology if you have not 25 years previously helped science. If that was not done then the only possible alternative is for you to buy your ideas from somewhere else. That is possible, of course, but it will not go on forever.

It seems to me that we must keep in mind that although our immediate goals, both social and scientific or technological, have to do with the immediate problems we face as Canadians, we must nevertheless realize that our ability to face these similar problems 25 years hence is going to depend on the health of our basic science in the present and immediate future. The university obviously plays an important role in this process.

I do not need to go through the details, except to point out that the university's business, first and foremost, is education. The carrying out of research is a by-product of education. I claim that it is a necessary by-product, because it seems to me inconceivable that we can educate people to carry on activities in these areas unless we represent these areas in an active and up to date way within the university itself.

The university has an additional advantage that comes from the fact that often the most productive work is done at the interface of different disciplines, and it is at the university that these interfaces most readily occur,

and where the greatest multiplicity of interconnections can be found. If the university has a role as an institution concerned in research it has that role particularly in the sense of its being an interdisciplinary institute.

Finally, if I may say what I am sure all of you know better than I, Canada has a particular place it seems to me in questions of this sort. The commodity that will command the highest market price will be knowledge. Raw materials of the kinds that we find naturally and free are available in one sense or another, and our economic system makes our materials available essentially on a world-wide basis, but the commodity which will distinguish the forward nations from the backward nations in some future era will be the possession and generation of knowledge. I would claim that Canada cannot afford to neglect that factor. We shall not achieve eminence through size—geographic size, perhaps—in terms of population or the human dimension not at all for a long, long time, but it is entirely possible, in spite of the limitations which we face, to achieve eminence in selected areas of endeavour in the social sciences, in the humanities, and in the natural sciences. I think we must never limit ourselves as to the equality of the work which can be accomplished in these areas, although we must necessarily limit our thinking as to the quantity that may be legitimately attempted.

Therefore, I would close with what I think is an obvious statement, that a country like Canada, limited as it is in some important ways, need not be limited in the quality of the science that it undertakes.

The Chairman: Thank you very much. We shall now hear from the Université Saint-Paul, the University of Ottawa, the University of Toronto, the University of Western Ontario, and York University.

[Translation]

Reverend Father Marcel Paity, O.M.I., Rector, St. Paul University, Ottawa: Mr. Chairman, we were very pleased that the Senate of Canada should take an interest in human and social sciences and research in religious studies.

To add to what has been said so far, I wish to say that, because of the interest my university takes in religious studies, we find it particularly...

[Text]

Senator Yuzyk: Mr. Chairman, we are not getting an interpretation.

Reverend Patry: Then I will speak in English. At Saint Paul's University we find there is a field of research in the domain of religious studies. When we look at the religious origin of our country and our universities, particularly in the field of law, we find there are possibilities for research in the domain of what we ordinarily call religious studies. We hope that the Canadian Senate will give attention to this area of social science, human science and religious science.

On looking at the Canadian Constitution, especially when we try to define the rights of man, there is a special place for religion in the rights of man, and a place for research in that field of religion. This is why we are glad this inquiry has been undertaken by the Canadian Senate, and we hope it will result in assistance for those who want to conduct research in the field.

[Translation]

The Chairman: Thank you, Father. I am truly sorry that our simultaneous interpretation service is not functioning this afternoon; the people are probably tired after this morning; they are not used to it, here in the Senate. However, we thank you for having been able to express yourself in either language—that is, as they say, either the confidential language or the official language. Dr. Chagnon?

[Text]

Dr. M. Chagnon, Vice-Rector (Academic Affairs) University of Ottawa: As the languages bill is only at the committee stage at present, I suppose I shall be doing nothing illegal in switching into English!

The Chairman: It has not reached the Senate yet!

Dr. Chagnon: In order not to take up too much time, may I first say that we did not prepare a brief from the university. The problem was discussed at the university Senate, and in small groups of representatives of different disciplines. Many of the professors and others who have accompanied me here today have worked on the preparation of briefs from different associations and organizations that have already presented briefs here. One could have voiced opinions which may be known to you, the Dean of

Science, Dr. Marion, is presently in Montreal receiving the Montreal Medal, and I will see that you get a copy of his speech, which might perhaps make better reading than listening!

There are four topics I would like briefly to mention. On referring to the terms of reference of this committee we notice that you are concerned to some extent with the problem of structure within the Government itself. We do not believe we are able to suggest to the Government how to set its own house in order—if need be, of course—but we would like to mention one problem that has been faced by many of the universities, or by many of the individual research workers, namely the lack of, I do not want to say centralization, but co-relation (at least from the point of view of an external observer) between the different granting agencies, or the different agencies and organizations or organisms that decide on or have anything to do with research within the federal Government. Whether this co-relation should be so formalized that it comes under the authority of one minister, or should be so formalized that it comes under the authority of a committee of the Cabinet, is I think a question to be answered by the people from within. However, I think we can say that many people in the field feel that there is a need if not for coordination and unification, at least for some co-relation between activities in the Government itself.

The second problem of structure is the structure of the organisms that are granting agencies, such as the Canada Council and the NRC. The suggestions of the Macdonald Commission were analyzed, and the reaction was not unanimous. In general, however, it is believed that the system presently working should not be disturbed too much, but instead progress should be made within the internal organization of the existing agencies rather than change. Besides all the theoretical or logical reasons one can give, there is a very practical reason for that. We have a fear that any major change will require a change of legislation, and it seems to us that a change of legislation may take two or three years. We are afraid of a “freeze” while waiting for the change of legislation, so we would rather work within the existing organism, which would not require a change of legislation to arrive at major structural changes in these agencies.

The third problem is one of the grants, themselves, and I think it has been mentioned or suggested by some of the speakers here this afternoon that it is quite difficult to visualize—and this may be one of the weaknesses of the Macdonald Report—a nationwide recipe that applies to all disciplines and all types of institutions. The needs vary and I think there is a need for more flexibility than we find in the Macdonald Report for the development of regulations governing the various types of grants.

We may point to one special problem, that of grants in the field of humanities and social sciences and the need for revision of this field. It is not universal, but in many cases they are very different from the type of grants that are given in pure or applied science. Very few grants in humanities and social science enable a professor, for example, to really offer substantial financial help to his students, and therefore there is a difference of status in this area between the humanities and social sciences.

The Chairman: You mean that the social scientist is forced to do his own research?

Dr. Chagnon: He cannot use academic slave labour, in other words. The sources also are much more limited when we think of the sources of grants for science that come from outside the Government, such as from industry and so on. The sources are much less varied so there is, I think, in developing both structures and regulations in the field of humanities and social sciences, a need to consider the special requirements and special state of development, especially at this point when humanities and some of the social sciences and humanities, introduction of mathematical models, and so on, is gaining in popularity. There is a need to give these research workers the same facilities that have been given to other fields.

Just one last comment. You are also interested, as a committee, in the development of or in discussing the policy for science in Canada. There is one remark here. It is simply that although we feel there is a need for such a thing at the federal level, we hope that any structure or any regulations given in this area will not kill the spontaneity of research work. That is to say, although we think there is a possibility of giving a policy of science and of giving some guidance, we would not like to see *du dirigisme en sciences*.

I will close with these remarks, Mr. Chairman.

The Chairman: Thank you very much.

Senator Cameron: I am sure this is the first time we have seen so much slave labour around this conference table.

The Chairman: Dr. Robinson from the University of Toronto.

Dr. G. de B. Robinson, Vice-President (Research) University of Toronto: Thank you, Senator Lamontagne. I should like to briefly describe the situation at the University of Toronto. We have an organization which attempts to bring together the problems of the university in the area of research, which was established five years ago—the Research Board. It has three committees, one on the humanities and social sciences, one on the pure and applied sciences, and one on the health sciences, each consisting of roughly 10 people.

These committees discuss these problems and when they are in their particular area, provide the solution, such as internal distribution of funds, and so on.

The Research Board sent a brief to the Lamontagne Committee several months ago. We also sent a brief to the Macdonald Commission. These documents are, to some extent, out of date, now that the Macdonald Report has appeared, but I might just briefly mention one of the points that we made in our brief to your committee. It was trying to be very practical. The former speaker referred to the increasing similarity between problems arising in the social sciences and in the national sciences and applied sciences. These lie largely through the use of a computer and the enormous increase in the problems which this produces. It has been a serious matter of concern to us at the University of Toronto. In that brief to the Senate committee we strongly proposed that granting bodies take into account the amount of computing which would be involved in a project. As of now, the National Research Council does not do this. There is some word that the Defence Research Board is doing this or is going to do it, and that the Canada Council is considering it.

The problems which are created by blocking grants to universities are apparent, I think, if you consider the nature of the case. The granting body may make a grant for \$10,000 to an individual and take no account of the fact that the problem which he is considering may involve computing, evaluating

perhaps, at \$100,000. It is this difficulty which we believe must be faced right across the board. It has been faced in all the American institutions, and grants from American granting bodies include an evaluation of the project from the point of view of the computing which is required. That was one of the major points which was put into the brief and in view of the fact that it did not seem to have been perhaps sufficient to emphasize, subsequently, I mention it now.

The Chairman: It was right on the line in the Macdonald Report.

Dr. Robinson: It is very important. We had a meeting of the Research Board last week on the Macdonald Report. The time to consider this document has been so short that our discussion of it was far too limited. We produced a consensus of opinion, but I will only briefly refer to this.

The problem of bringing together the necessary copies was solved. They were not sufficient in the City of Toronto. We had to import 60 from Ottawa. The wife of a Member of Parliament happened to be driving down and she was able to bring us enough copies for a sufficient number of people to read the document so as to form some sort of opinion. We do feel that the study has been too brief. The comments which I might make on the report have come up in the previous speaker's summary. It deals primarily with the councils, and in the Research Board in my office of research and administration at the university, and we find that this is perhaps less than half of the problem.

The problems come up with regard to Government departments and also from the outside world. I do not want to go into details here but I think it is essential that the Senate committee look at these problems which come up through the granting by Government departments independently of the Councils. This is not systematized and we would be very happy if the Senate committee could give it a very careful survey. I have made a brief summary of our meeting last week on the Macdonald Report and I will read it and then I will turn the minutes over to you.

The meeting was called to discuss the Macdonald Report, to instruct me as to how to present the opinion of the University of Toronto. I have brought Dr. George Connell from the Faculty of Medicine with me since he supported the motion of general approval given by the research board to the report.

He is able to answer many questions which could be placed and which I would be happy to have him answer.

Our office, through the kindness of a member of Parliaments' wife, was able to procure 60 copies which we distributed prior to our meeting. The report contains a vast amount of very valuable statistical material which is subject to varying interpretations. The academic world has been frustrated in dealing with granting agencies and Government departments largely through our inability in some cases to introduce what we consider to be rational procedures. The importance of the conclusions expressed in these minutes lies in the general approval of the aims motivating the Macdonald Committee.

I think we are all agreed that they had the fundamental issue, namely, to establish right relations between the universities and the Government, deeply at heart.

The limitations on such approval refer to the means proposed principally in Recommendations 3, 4, 5 and 10 for accomplishing an improvement of relationships between the federal Government and the universities.

It is perhaps worth mentioning that Dr. Gordon Patterson suggested that early implementation of Recommendation 6 might provide an opportunity for further discussion of difficult issues. That is, the co-ordinating committee between the councils.

This proposal was accepted without a vote. The fundamental thing is that we are heartily in favour of the work that the committee has been doing and would not like to see it destroyed by a criticism of detail. This is the important thing, as we see it.

The detail, of whether this council or that should be split up or not be split, that can be settled. The very important issue is to establish the relationship between the universities and the governments, and the federal Government, on the basis which will create as little friction and misunderstanding as possible.

The Chairman: I knew that parliamentary wives were very useful to Members of Parliament, at least to most of us, but I did not know that they were also helping Mr. Kierans.

Now, Dr. Carroll, from the University of Western Ontario.

Dr. John M. Carroll, Associate Professor of Computer Science, the University of Western

Ontario: Mr. Chairman and honourable senators, we see the goals of national policy for Canada as follows: (a) to increase the number of scientific, engineering and technical jobs available to Canadians, (b) to aid in regional development within Canada, and (c) to equip Canada to provide scientific and technical leadership to underdeveloped countries of the Commonwealth and the former French union.

We feel these goals can best be realized by a national scientific effort balanced among three categories: (1) basic research, (2) applied research, and (3) technological development. I will consider each one of these briefly.

Basic research is primarily the purview of the universities, although not their only concern. The present effort in this area is excellent but continuing Government assistance is required to sustain and enhance both its quality and quantity. This assistance may come in five ways:

(1) Support of qualified graduate students. We recommend also that assistance be given to promising pass graduates of Canadian universities who want to upgrade their qualifications to undertake graduate work.

(2) Fellowships to permit Canadian students to travel, study and work abroad or in other parts of Canada, to improve their scientific skills.

(3) Sponsorship of visiting scientists and scholars.

(4) Grants to cover capital expenditures for land, buildings, and non-expendable research equipment required either for research or related educational programs.

(5) Operating grants to establish centres of excellence in critical disciplines.

As regards to applied research, this area has been stunted in Canada, primarily because of the branch-plant problem. For this reason, applied research is largely now in the hands of Government agencies.

The principal agency is the National Research Council laboratory. This centre should continue to be supported and its functions expanded.

Overall, the applied research done by Government agencies should be co-ordinated by liaison between the NRC laboratory and other agencies undertaking work of this nature.

We recommend that several new national science institutes be created. I add parenthetically that these could be within or outside of

the existing NRC structure. These institutes would function both as granting agencies and as centres for intramural research. Some of the key areas of interdisciplinary activity we see as: cybernetics and systems science; educational technology; materials sciences; marine sciences; and scientific and technical information.

I want to enlarge briefly on the last field.

This institute would not only conduct research but would also disseminate information, be responsible for standardization, and maintain a real-time on-line computer data bank that would correlate information regarding research projects, maintain a national inventory of scientific skills, maintain a central registry of specialized research equipment, and assist in the planned budgeting of research expenditures.

Finally, in the applied area, we recommend a vigorous program at federal level to encourage industries operating in Canada to establish research and development laboratories here.

In the area of technological development, we believe it should be promoted by an interplay of public and private resources in imaginative new industry-university complexes. Here we suggest performing special developmental work for Canadian firms at cost in government laboratories, and providing government testing and standardization facilities for use by Canadian industry to promote consumer protection, compatibility of technical materiel, acceptance of Canadian products in the export trade, and insurance against environmental pollution by new processes and products.

Other activities might include disseminating scientific and technical information to Canadian industry; encouraging the training and immigration of skilled manufacturing technologists and scientific technicians; and establishing norms for the application of modern manufacturing technology in Canadian factories.

We suggest that the foregoing program be implemented by a cabinet-level Department of Science and Technology which will fix responsibility on a single minister of the Crown. This department would provide a home for the National Research Council and for the proposed new scientific institutes mentioned previously.

The staff of the deputy minister of this department might well be responsible for correlating the experience of federal granting

agencies and maintaining liaison with other government research laboratories in order to advise the minister on long-term science policy.

Dr. John Hart, Chairman of the Computer Science Department of the University of Western Ontario will now enlarge upon our proposals in the area of cybernetics and systems science, and educational technology.

Dr. J. F. Hart, Head, Computer Science Department, University of Western Ontario: Mr. Chairman, perhaps we have used up our allotted time, and I could save my comments for the question period. I would be quite happy to do that so that we would not hold up the proceedings.

The Chairman: We will make sure you come in at some stage, Dr. Hart.

We will now hear from the University of Waterloo.

Dr. E. L. Holmes, Associate Dean, Faculty of Engineering, University of Waterloo: My colleague, Dr. Sherbourne, Dean of the Faculty of Engineering at the University of Waterloo and I will be very anxious to participate in the discussion of our brief. As the writer of the brief, I must apologize to you, Mr. Chairman; for, after having seen many of the other briefs, I realize they are much shorter and to the point than ours. However, in order not to be verbose this afternoon, I will avoid repeating what we have said in the brief and will just highlight one or two items included in it and indicate just what we have done about them at the University of Waterloo.

One of the suggestions made in the brief was that there should be more institutional co-operation and co-ordination of effort among the universities. We are working quite hard with some other neighbouring universities to bring this about, and as one example we are hoping to get things on the road in the field of water resources among the consortium of universities, and hopefully with the Inland Waters Research Establishment at Burlington, Ontario.

We are getting together with respect to our efforts in connection with CEDA and relations with institutions in other countries, particularly in the developing countries. We feel very strongly that the *ad hoc* approach by the filling of teaching slots is not really the best approach to take. It does not benefit either the overseas universities or Canada to the extent it could. We feel quite strongly that, if we can

build up some expertise within certain Canadian universities about certain institutions or countries in the developing world, then we can have much bigger impact, and, to this end, we are co-operating with our neighbouring universities to try to pool our experience and make specific contact with various universities overseas.

Another topic I should like to highlight is the question of the relevance of our research and the question of whether or not our PhD's are likely to be wasted.

It appears that as an aggregate the country is pretty well capable of producing all the PhD's it needs at the present time, given the present patterns of usage.

I think we should look very carefully in connection with other ways of using these PhD's and I think this will demand a certain amount of flexibility among PhD graduates themselves and also among the faculties within universities as well as among people in industry and government, with respect to their attitudes regarding the potential usefulness of PhD's in a variety of endeavours.

This is one of the things we dwelled on at some length in the brief in which we referred to possible reappraisals of research structure, the PhD degree, etc. Regarding this question of the arrangement of our research efforts. Within engineering we are attempting to break down some of the discipline orientation of the research and are making arrangements to build on a divisional structure. Certain disciplines are coming together and we are building research divisions. This seems to be paying off extremely well in the fact that for example people in manufacturing sciences are coming into much closer contact with their colleagues in applied mechanics, and I think each is learning from the other. We are developing our work in management sciences, and so on. We are making efforts to diversify our research support sources and are seeking a closer involvement with industry.

I think this is about all I will say at the present time, Mr. Chairman. Our brief was rather voluminous, but my colleagues and I will be pleased to take part in any discussion you may have.

The Chairman: Naturally, your brief will be part of our proceedings. Thank you very much. Now we will hear from Dr. Schiff of York University.

Dr. H. I. Schiff, Dean, Faculty of Science, York University: Mr. Chairman, members of

the committee, as our university has submitted a brief to this committee I will not repeat anything that is in it. I will ask your indulgence, however, to use this time to make a few random remarks on things which are not official university policy but which are close to my heart.

First, if I will not be accused of patronage, I should like to express my sympathy for this committee. It must be a very confusing thing to try to assimilate data.

As short a time ago as seven years I was present at a presentation by the National Bureau of Statistics at which the chief statistician made a statement to the effect that Canada would not be producing sufficient PhD's by 1970 to meet the needs of universities let alone the needs of government and of industry.

This last year we heard the President of the National Research Council say that we are over-producing PhD's and will have to put the brake on. But that statement has now been countered with the suggestion that we are not over-producing but are under-employing PhD's.

How you make sense out of this sort of data, I am not sure. But just to add to the confusion, let me make a few remarks on that point. It is a question which has concerned me greatly as the university's Dean for the last few years. Perhaps it would be refreshing to the committee if, instead of blaming them or the Government, I were to focus my blame on the universities first.

I think we are very capable for the present situation. I think that part of it comes from our own prejudices. We start inculcating in our students right from freshman year on in our science programs that pure science is the only pursuit; that it should not become polluted or contaminated; and in what we are teaching little relevance to society ever gets into our discussions.

We do this partly as a protective mechanism, because few of us have ever been outside our ivory towers.

We then point out to the students that the honours degree is certainly the only degree and that the ordinary degree is a consolation prize; and, furthermore, that, if they are any good, they must go on to get their PhD's. And then, at the Ph.D. level, the more esoteric the thesis subject the more value it is considered to have.

What we are doing, then, is producing carbon copies of our ourselves, because, after

all, we have turned out so well the best thing we can do for the students is to make them over in our own image. These PhD's find themselves faced with two difficulties. Their first difficulty is in getting jobs, but an even worse one is the fact that frequently they do not want jobs outside. They want jobs in the university. So we have helped to create this monster ourselves. Now I think we have to do something about this. I think what we should do is this; we have to start very early in our educational pattern relating what we are teaching to outside society. Part of the student movement at the present time is, I think, caused by this lack on our part in the past. They do not see the relevance of what we are teaching. It does not "grab them" as they say, and I think this is what they mean.

What else can we do? Take any of our universities at the present time, and in particular take the one with which I am most familiar. This year we will bring in 350 freshmen students in science. Frankly I do not think that there will be 350 professional scientists in the bunch either through interest or ability. I am not saying they are stupid, but they are not that "grabbed" with the subject to want to become scientists in the real sense of the word. Should we hold this program out to them as the program they should endeavour to follow? I think a greater need in this country than that for professional scientists, although there may well be a need for 10 per cent or 20 per cent of that group who will make professional scientists, but, the greater need is for a higher proportion of our people to have based their careers on the science basis rather than on the traditional arts basis. Science is playing a greater role in our society than in the past in decision-making, and if government and industry are to make decisions involving vast sums of money, they must have the necessary scientific background to enable them to make valid decisions. Some though should be given to the presenting of careers in political science, market economics, administration and so forth on a science basis rather than on the traditional arts basis. A larger number of people should enter these professions on a science basis, that is to say on a basis that will make this a more logical process. That is another suggestion I would like to make.

But lest the government is going to feel it is going to get off scot free in what I am saying, I would like to address some of my remarks in that direction as well.

The Chairman: I knew there was a "but".

Dr. Schiff: The thing that has impressed a number of us is the fact that we have been crying about this branch operation in science and R and D in this country. By this we mean big science, and one cannot help but wonder where is the little science. Where are the small companies, the innovative companies that you find around route 128 and Boston? We want these in Canada. We do not want to be just importers of ideas from elsewhere. We have the scientific personnel here who can produce the necessary innovations to provide for industry in the future. This has been successful in countries that are not as large as Canada. Is it because our scientists are gutless and that they do not have the nerve in doing these things that the outfits starting in the States have? What is the reason for this? To this end a group of four of us six months ago formed amongst ourselves what we called "Operation Innovation". The members of the group were Dr. Campbell, Director of Research of the Ontario Research Foundation, Dr. Grace, Director of Research of the Dunlop Corporation, myself and Dr. Ham, Dean of Engineering of the University of Toronto. We have been looking into this question to find out what is wrong with the personal or environmental support which prevents this kind of thing from happening here. We have made a survey of some of the companies who have done this and who have succeeded and invariably we were informed that if they had to do it all over again, they would start in the States because the support and the climate here were not conducive to achieving success. As a test we set up a company with bright ideas and we started out to get support for it. Even yesterday I was at the National Research Council to find out what the government does to support new ideas. We all know what they do about the old ones. We wanted to find out what they would do for the entrepreneur who wants to start a new business, or a university professor and some of his students who want to start a company. The answer I received was "we do not have that mechanism". This, I suggest, shows a very serious lack in science policy in Canada.

Finally, I would to caution against another "in" word that one hears a lot at the present time, and that is that all research should be mission-oriented. We have to think about the direction in which a program is going because our resources cannot handle them all. Well, I would like to echo Dean Harrower's remarks

that there is a danger in pushing this too far. I think it is the university's business to be aware of what is happening in society. It does not follow that it has to be involved in leadership, but it must be aware. But our main task is to know what is going to be the pay-off in 10, 15 or 25 years. I would recommend for reading that wonderful document of Alex Douglas, Director of Physics at the National Research Council in which he gave five fictitious reports of government committees in Canada over the last 25 years in one of which they started off damning aircraft and so forth as not being of any interest. Some of you may have seen the article in the *Financial Post* some time ago called "Honey of a Memorandum". This was supposed to be a memorandum sent out by Western Union when asked to consider Mr. Bell's invention or idea, and they said it had no practical application whatever.

The Chairman: Thank you very much. Senator Grosart has been silent for almost a day, so I will allow him to ask a few questions.

Senator Grosart: Thank you, Mr. Chairman.

I should perhaps say at the start, for the benefit of those who have been good enough to come here, that if some of us have come in and have gone out it is because we have other committees sitting, and there was an urgent call out for votes pro and con on what is now known as the Hate bill. Some who may have been sitting in this committee all day may have been ducking that vote!

The Chairman: I am sorry, but I am a member of that committee too.

Senator Grosart: I was not referring specifically to you, Mr. Chairman, but I thought that would be of interest to you, that the vote is over.

Mr. Chairman, if I may—because I do not think any of us have had the time to go over all the briefs, because they have come in in rapid succession in the last 24 hours—I would like to deal with two from Toronto, to start with, York University and the University of Toronto. Perhaps this is appropriate, because the University of Toronto is my alma mater. One reason I like to couple these in my questioning is that both seem to be in favour of an overall body. If I may quote the statement

from York University, in their recommendations at the end, on page 12, the paragraph reads:

Is there really a need for a separate MRC, NRC (and we hear) and Engineering Research Council? This seems to be a fragmentary move. It would seem that one science body would far better administer the federal support of scientific research to Canadian universities.

And in the recommendations of the University of Toronto, No. VII is not quite as strong, but it says:

The distribution of government funds for support of research and also the way in which the funds are utilized by government departments, agencies and councils should be the subject of advice and criticism by a duly constituted government body.

I hasten to say that neither of those specifically says that we should have a Minister of Science Policy. They do suggest, however, that there should be one overall body in which there would be adequate, perhaps majority representation from the universities, to provide the essential input of science into Government science policy in this and other areas.

Let us work on the hypothesis, for the moment, that some such body might be the right answer. I would like to illicit some comment as to the kind of body and what its function would be in respect to advice only to the political decision-maker, to the administration of grants and/or contracts, and to the funding activities in departments, agencies and other instrumentalities of Government.

The Chairman: In other words, now you have probably to write a very important part of our report.

Senator Grosart: That is what I am getting at, Mr. Chairman, because I might say this, that to date we have had very evasive answers to similar questions.

Dr. Robinson: You mentioned York University first...

Dr. Schiff: Not only is the University of Toronto my alma mater, but this was one of my professors.

Dr. Robinson: I do not mind saying what I think personally on this. This is a problem on which it is very difficult to get everyone to

say exactly the same thing, so perhaps I may be permitted to give my own personal views.

The statement you read from our brief was not to say that there should be one granting body, but that there should be a body which would comment on and advise on Government policy. I think there is a difference. I am not saying that the other proposal has not merit, but it simply never was systematically considered in our research board.

The discussion with regard to this balance-wheel activity, as one could call it, is, I think, very important. It is hard to know the inner workings of Treasury Board, of the chairmen and deputy ministers in the federal Government, from the outside.

Senator Grosart: It is fairly easy to assess the results though.

Dr. Robinson: Yes, it is fairly easy to assess the results.

What we had in mind there was simply that the problem which the university faces does not come—and this is really what I was referring to in reference to the Macdonald report—to the surface quite so clearly in the research councils, where you have a very clear distinction between the university role and the government role. It does not arise at all in the Medical Research Council or in the Canada Council.

The problem we are thinking of here is the problem which arises through Government granting agencies in the large departments. If you go back to before the war, these problems hardly existed; the National Research Council was the scientific agency which dealt with the universities. The problem has recently been very greatly accelerated in its development through the entry into the field of, say, the Department of Finance, which is in great need of advice on quantitative matters and we have the Institute of Quantitative Analysis which has been growing enormously, and the money from outside has come into the Department of Economics on a scale which none of us even remotely expected. The needs of the Government are such that they practically could buy up the whole department. Let me state another example. The Department of Energy, Mines and Resources has also very great needs, and this problem of pollution is foremost in many people's minds.

The problem that the universities face is that of establishing a relationship where you have the Government planning the research

and the universities being involved in some way in getting the two sides to sit across the table and talk about the problems.

I am reminded of a situation which developed after the war in the United States where the development of atomic energy had led to large accelerators, and the Brookhaven proposal was being made by the Atomic Energy Commission. The proposal was to build this large accelerator, and the eastern universities were asked to participate. They said: "We will not take part in this unless we can be part of the project", and that led to the organization of Brookhaven where the universities and the Government took part in planning the project and incorporating it.

Now, this recommendation that you refer to was designed, or hopefully planned, to introduce this sort of co-operation between the universities and the Government. It is not that the universities want to take over by any means. They want only to be able to say to the Government: "We have students. We are the people who educate the staff whom you want to hire. Therefore, there are certain aspects of the research which can best be done by students in relationship to these projects." If this is to take place in a healthy fashion then it should be possible to talk about it across the table, and it should be possible to plan it without the planning being done by the Government department and then the proposal being put to the university by saying: "Come along and do your work, but on our terms."

That is all that is meant there, and I think that this is a very important thing. That is the explanation of that recommendation.

The Chairman: Perhaps we could have a comment from the student?

Senator Grosart: I would like to make a sandwich of comment here because I would like to quote from the brief of York University. Dr. Robinson, I think you have re-stated the problem. I can speak only for myself, but I would guess that practically all the members of this committee are in sympathy with the aspirations of the universities for a much more workable form of liaison, but we keep coming back to my question: How?.

It seems to me that your problem predicates a decision. It is all right to talk across the table, but somewhere there has to be a decision. The big problem is: Do we leave it to the Treasury Board in the long run, which seems to be what is being done now, or do we

leave it to a minister, or to a committee of the cabinet, to assess all the conflicting claims which is a proper function of the politician, but one that is almost impossible to achieve with any kind of efficiency in the field of science? Do you see this body, or another body, or any body having a useful function in sorting out the claims and presenting some kind of a suggested answer to the conflict to the political decision-maker?

Dr. Robinson: May I answer this, Mr. Chairman?

The Chairman: Certainly.

Dr. Robinson: I got carried away with stating of the problem, I quite admit. My own personal view is that it has to be a body as closely related to the cabinet as possible. I do not think it should be only the Treasury Board, I would like to put it in this way, that it has to involve the Government in a very responsible way. It has to involve the universities, and it has also to involve industry.

These decisions, to my mind, impinge on so many areas that I personally would suggest the role that is being played now by the Science Secretariat and the Science Council should be expanded. I am not prepared to go into details here, because I think this is an area which is very closely related to organization.

Senator Grosart: Dr. Robinson, I am not really asking who should do it, but how it should be done.

Dr. Robinson: I firmly believe that it has to be done. I firmly believe that somebody has got to say that such and such a department should not expand indefinitely the in-house research. I believe this is a problem that must be discussed in relation to industry, the universities, and the Government, and I would suggest that a body—I do not want to be any more specific than that, but I think it has to be planned and to have representation in these areas.

Senator Grosart: I should like to direct the same question to Dr. Schiff of York University. I will preface it by saying that I am in complete agreement with the first numbered paragraph in the introduction which reads:

There is still no really informed professional scientific opinion among members of Parliament, the Cabinet nor the Senate.

Dr. Schiff: That was written by a colleague of mine.

Senator Grosart: That is the problem. I do not say that facetiously. How do these people who are going to make the decision become informed?

Dr. Schiff: Perhaps I should, first of all, put the paragraph you read earlier into context with the other one because our concern here was that this tendency to fragmentation of the different granting agencies, particularly at a time when all the talk is going on about the need for interdisciplinary work and the inter-relationship between pure and applied science, and when the boundary lines between the classical disciplines has disappeared, and the real action seems to be taking place where physics and chemistry are applied to biology and medicine. You now have the Medical Research Council which seems to be constantly saying to some universities: "We cannot support you because you do not have a medical school."

Senator Grosart: You are stating the problem, Dr. Schiff. I want the answer. We have reams and reams of statements on the problem.

Dr. Schiff: I agree. I do not really think I can write your recommendation for you. All I can do is say I agree with Dr. Robinson that there should be one body, whether it be a national foundation or a national science council, that encompasses all the areas referred to, and that has to be made up of representatives from those three main branches of the community—government, industry, and the universities. The National Research Council has done a remarkably good job in the natural sciences in being fair and conscientious and not having a conflict of interest in the past between their in-house research and their support of universities. However, I am not sure that they can continue fulfilling that function as equitably as they have been able to in the past.

The Chairman: In order not to limit this to a Toronto dialogue, I would like to ask if other university delegations have some views to express in answer to Senator Grosart's question.

Senator Grosart: Could I just add one more, which may help anybody in answering? Would you see this advisory body as an enlargement in role of the liaison coordinat-

ing body suggested by the Macdonald Commission, sitting over the three councils? Would you see it in some dimension such as that?

Dr. Paul Hagen, Doyen des Études Supérieures, University of Ottawa: This view is not necessarily that of the University of Ottawa, but it is something that I think should be borne in mind. It will not solve or even help to solve the problem posed in Senator Grosart's question, which is a bit more complicated. I believe that anybody concerned with making decisions about the partitioning of money for scientific purposes should not be restricted to the three councils just mentioned, to overscanning the three councils, but should be concerned with the whole federal Government policy. Anybody concerned with university support in terms of three or more councils like that would immediately be identified as a body supporting university research; it would be an educational body; it would become vulnerable to provincial ambitions, of Ontario and Quebec anyway; these provinces would immediately say it was supporting education. Anybody responsible for partitioning federal funds for science support should, first, not be specifically identified with support for university research solely, but should be a body responsible for federal science policy in general, which might include university support.

Secondly, any such body should in fact favour to a large extent the fragmentation of supporting organizations. The more of them we have the less vulnerable they are to provincial takeover—if we are in favour of federalism anyway. The less they can be identified as a single body supporting university research the better. I think this is a political fact of life that we have to live with; the more we fragment them the better. We need some organization that knows what it is doing and can advise the federal Government about this. I think this is a very important consideration to bear in mind.

Senator Grosart: I am very glad that statement has been made, because I was asking the context of the Macdonald Report. Obviously now we begin to see an American pyramid; we have the three councils, then we have the other councils that the Macdonald Report found necessary to indicate, such as the conglomerative task forces running around the country doing laboratory work.

The Chairman: They call it the coordinating committee.

Senator Grosart: They had a coordinating committee, but they had a bunch of task forces running around the country substituting for the in-house research of NRC and several others. If we take all these together and put a super university advisory granting council on top, we have to put another on top that decides how much goes into the university side, how much into in-house and how much into industry. That is why on the evidence so far my inclination is to spend most of my thinking on the problem of the one body, and then let us work down. I am not suggesting we should not work up to the one body with all the advice we can get, but I am very glad that observation was made because I did not intend to restrict myself to that question.

Dr. D. W. Slater, Dean of the School of Graduate Studies, Queen's University, Kingston: Senator Grosart has asked whether this body should be purely advisory and have responsibility for grants, should it have the role of being advisory grant-making and coordinating.

Senator Grosart: And administrative.

Dr. Slater: And administrative. My impression is that bodies that are purely advisory have very little long-term impact on things. If they are to be advisory they must have some responsibility such as granting, a combination of granting and advice, and work a good deal better than purely advisory bodies. On the other hand, you have the problem that any granting body playing an advisory role will inevitably have its limitations, and one cannot rely only on this. My guess is that the Treasury Board will have to be informed. There is no substitute for that. The bodies that are granting will have to be informed and in a position to give advice. Then there will clearly have to be some coordinating bodies at least that not only pull together the various federal government departments and granting activities, but also provide some kind of vehicle for communication with provincial activities and Dean Hagen has pointed to the problem of provincial takeover. I think it is an elementary fact of life that for as long into the future as we can see our provinces will have a very important role in relation to universities and research, and we really must find means of coordinating federal and provincial activities.

The Chairman: Before we continue with this discussion, I would remind you that we have organized a kind of plenary session for tomorrow afternoon at three o'clock with all the university delegations who will be able to attend that meeting. I have just received a telegram informing me that Dr. John Macdonald and Dr. Duprés, who was also very active in the preparation of the Macdonald study, will be with us tomorrow afternoon, so those of you who have not read the Macdonald study might well devote this evening to doing so.

Senator Grosart: My final comment is that perhaps the political solution might be to have this overall top body, perhaps called an advisory body, and insure that the terms of reference make it clear that it has no control of anything whatsoever, but also making sure that the Treasury Board takes their funding recommendations!

The Chairman: Before we go to another subject, and perhaps also to questions from another senator, is there anybody here who would like to comment on this vital issue? It is, it seems to me, vital to the future of our science policy.

Dr. Robinson: I wonder if Dr. Connell would like to speak on this from the medical point of view?

Dr. G. E. Connell, Chairman, Department of Biochemistry, University of Toronto: As Professor Robinson has made clear, the members of the University of Toronto are content with the separate structure of the council as it exists now, and particularly in my own field, which is related to the activity of the Medical Research Council. The work of the Medical Research Council, I think, has been most important for the development of research and, therefore, for the development of all activities of the medical schools in Canada over the last five or 10 years. I think the recommendations of the Macdonald Commission, that this council should remain in fact, would have full support of members of our university.

The Chairman: No other comments? Senator Cameron, do you have a question?

Senator Cameron: This is, first of all, by way of an observation. I was very pleased with the refreshing comment of Dr. Schiff of York University, because I am one of those

who have felt all too long that the universities have not taken as much initiative as they might have in becoming related to industry and to the everyday facts of life. As you know, some members of this committee spent some time in Boston, and certainly one of the highlights of our visit there was the half day we spent with General Doriot of the American Research and Development Corporation. The other half day we spent with the Arthur D. Little Company, to see what these people were doing in translating the ideas from the university into practice of everyday industrial development. I believe we have a Canadian equivalent of the American Research and Industrial Development Organization, but it has done relatively little, at least as far as my information goes.

Now, Dr. Schiff, you have said that you and some of your colleagues have initiated a company which I presume is to do something similar but you are unable to get support. I gather from your remarks that you first came to the Government for support, like everybody else. Did you try anybody else?

Dr. Schiff: The answer is no, we did not come to the Government first for support. The first thing we did was to set out a task force, using Government techniques to find out what was available in the community from people who are already in such operations. The answer we got was that banks, for one, are extremely conservative in this country. You can get support on risk capital in the States, but if you have a building in Canada in which to do your research they will mortgage the building, but that is all they will do. They do not know anything about an innovative risk capital sort of thing. We found out there are some companies that are apparently coming into it. Aluminum Company of Canada is interested to some extent. Again, they are just starting on this. The answer we got from the innovative companies was that if you have an idea you can probably find risk capital in the private sector, but they will want, in order to cover their risk, a major portion of the action. It is going to be sort of a 90-10 per cent split. If the inventor or the innovator wants to really carry it on to a point where he can justify getting more of the action, there is not this kind of money available in the private sector.

When we came to Government we found that most of the programs now in existence are in support of existing R and D operations, that PAIT really comes in at a later stage and

there is not a mechanism at the moment to support the new entrepreneur.

Senator Cameron: From the practical experience you have had, has your group arrived at any conclusions or recommendations that you might make to this committee with a view to getting more of this entrepreneurship established in Canada?

Dr. Schiff: I would like to suggest that whatever this body is going to be that it also makes grants available again. The grants would have to be looked at and assessed by somebody, but grants available for innovation or invention. The group has approached the Ontario Government with some favourable reception to the idea of providing at the Sheraton Park area, buildings which they call incubator buildings and where you can rent a lab to try out your idea. The provincial government seems to be interested in that. They were not, however, interested in getting into making grants for the development of the idea.

Dr. A. N. Sherbourne (Dean, Faculty of Engineering, University of Waterloo): I would like to offer a few personal observations in connection with this particular topic since it bears on the whole question of relevance in education. In connection with the development on Route 128 outside of Boston, I would suggest that this was an outcome of an even greater sophistication and more PhDs rather than less PhDs. This is the first observation. I would like to make another observation as a Professor of Engineering, that the subject of relevance is very important to engineering since where science may be international, engineering certainly is a national activity and can be identified as such.

The Chairman: We were also told that engineers did not read the stuff of the scientists.

Dr. Sherbourne: I beg to differ. I think engineers read the stuff of scientists, but the reverse is not always true. I agree with Dean Harrower of Queen's, that one needs to preserve basic science. It is still, however, a matter of balanced activity where the ratio of support for applied science versus basic science should be in the ratio of four or five to one against the one to two which seems to prevail in the country at the moment.

I can see NRC proceeding in this direction slowly. I think if this is a problem it is a problem because some bad advice has been

tended by the universities to the National Research Council. All the advice on the university support program given to the National Research Council comes from universities. These are the people on grants commissions. These are the people concerned with the education of students and the people conditioned to change things, yet we persist in a policy which our council has learned from representatives of the universities and which is apparently unacceptable to the universities. Also in connection with the centralized body versus the decentralized approach I would suggest that we have in Ontario a system of a highly centralized nature where all universities come under the scrutiny of a single body; none of the universities seem to be entirely satisfied with this approach. Going back to the subject of relevance I would suggest that it really is not important what sort of education we give students, provided we teach them a few basic things, such as initiative, a sense of values and so on. One does not have to take a course in philosophy to be a philosopher. After all, even Bertrand Russell read mathematics.

A lot of highly specialized education has produced a lot of liberal thought. Again, I think the mistake, if there is a mistake, is that the economy has allowed our young people to believe that having obtained a PhD in a certain field, they are entitled to work in that field.

I should like to go back to the United States where in 1946 the universities led industry in the production of PhDs. They did not wait to find out what industry needed. They produced PhDs, because they felt PhDs would take the economy and shape into it what was needed. I suggest that Route 128 was just such an outcome and that sophistication followed overproduction of PhDs rather than waiting for governments to hand out grants.

John Deutsch, in connection with the most recent report of the Economic Council, in his remarks to the Association of Provincial Engineers of Ontario meeting at Niagara Falls, suggested that the figures of production and industrial needs are quite incompatible. If, however, we look at the increases of sophistication which may result in our economy, we may perhaps be able to absorb this apparent overproduction of sophisticated manpower. I suspect that we need to inculcate in our graduates the fact that the economy does not necessarily owe them a job until they make it sophisticated to the point where they can find employment of the type they

desire. I do not subscribe to the view that it is necessary to re-orient all our course of instruction.

It is said that this business of changing the face of society involves a greater concern with general education. We all have concern for society. If one wants to change it, however, one needs to think more of educational self-discipline, of education in depth, to achieve certain physical objectives. This is professionalism and cannot be achieved with superficial general courses.

Dr. J. F. Hart: On this problem of technology, the question which is being raised now and which is related to this problem, is how can Canadian science policy be developed so as to give proper emphasis to the emergence of new subjects of development as well as to existing research groups.

I can put this quickly into focus by referring to the development of computer science in Canada, by mentioning several points.

The first point is that there is only a handful of Canadian computer scientists who are known internationally and who are active in promoting computer science policy. The very small number at this meeting would indicate how few those people are.

Secondly, I believe that there are less than half a dozen Canadian universities with adequate undergraduate offerings in computer science.

Thirdly, I would like to point out that this committee has listened to Dr. Lickleiter and he is at the moment present at a conference in Ottawa. He spoke this morning to a program in connection with man-machine communication. There were a number of interesting points that he expanded on, probably relating to what you heard from him.

This was particularly embarrassing for Canadians, to realize that the kind of thing that he is doing is not being done in this country.

Perhaps I could focus on this a little bit by mentioning that he gave an example of how the various sciences can work together to produce something in the field of education and technology.

He has some students in a computer-graphics course and they have all used these machines, which will illustrate a different concept in the scientific field.

There are two points about this. This is a group of traditional scientists and their problems, but it is also a good way to promote research in learning.

This supports Dr. Guindon's idea of yesterday that research here could be the work of a whole university rather than the work of special research institutes.

The feeling about computer science today, with the federal-provincial program of educational support:

I see this quarrel with respect to education as a kind of neurosis holding back the profound desire of Canadian computer scientists and educationalists to develop the indigenous field of the research in this area.

I would like to be specific about this. Our department has been engaged four years in relation to work in geophysical mapping in Ontario.

We developed a major research project there.

When it was completed, it was applied, with industry, with the Department of Energy and Resources management. That program went to the Department of Energy Resources for management and has been used to assist in development of plans for drilling in the gas and oil fields in Ontario.

We then decided to get into computer-aided-instruction research inasmuch as it should aid in reaching the new goals set up within the university. We were able to get some small support from the Department of Education and we have a teletype in one of the local secondary schools. This has been going on for some time and we now have some sequences relating to trigonometry, which are being dealt with by the students of the local high school.

We have made a very thorough study of the amount of support in Canada for this kind of thing. We have seen the minister, two of the deputy ministers, the Director of OISE. We have good collaboration with OISE, except to the point where finances are available. We understand in Ontario no money is available for this kind of work.

We have talked to people at the federal level and there is no money there for this kind of work. I have been talking to other people today who are interested in this kind of research in Canada and find that they are concerned about the same problem.

I would refer finally to the statement made repeatedly to this group, to the effect that many American scientists believe that 50 per cent of the research money used goes under educational research to research in the knowledge field.

I would like to close by pointing out the disparity between this kind of development and what is now available or possible in Canada, as a result of the university federal-provincial difficulty.

Senator Cameron: I might assure Professor Hart that the committee was very much impressed with the \$25 million worth of equipment we saw there and also with the way his graduate students could play games with it.

The Chairman: They were working for the Department of Defence but they had all the flower power there in the labs.

Dr. J. S. Riordon (Faculty of Engineering, Carleton University, Ottawa): I would like to add a comment to Dr. Hart's statement. The federal Government is in fact interested in the large computer construction in the National Research Council. There has been a considerable effort on this. One student section of the engineering division is in this area now quite actively and also in concert with OISE.

The Chairman: Lack of co-ordination, perhaps?

Dr. J. F. Hart: No, sir, it is not. The difference is in the kind of objectives going into educational institutes, available for university, and is such that there is tremendous disparity, even if you compare the development of the NRC with that of the major universities.

Senator Cameron: There was an experiment carried out which you could relate to this, by the University of Waterloo, with industry in the area, whereby engineering students spent a certain amount of time in the plant. That program was carried out for a couple of years. I wonder if Dr. Holmes could give any comment as to how this type of integration between the teaching programs and the application in the factories has worked out, because it relates to what Dr. Schiff has been saying, and some others.

Dr. Holmes: All our engineering undergraduates are on this co-operative program with industry and there are about 2,400 undergraduate students at present on the program, which involves alternating four-month periods in industry.

In addition to this we have a fair number of mathematics students also engaged in co-operative programs and they are working largely with industries, banks, insurance companies and so on. We find that this has a tremendous impact on our undergraduates. They tend to be quite a mature group. They know what they want. They have also had broad experience, in being interviewed by industrial companies, and in being exposed to Canadian industry in general. They seem to be very sure of themselves particularly by the time they have reached final year.

We have a very small brain drain out of the country. We have taken statistics since the beginning of the program and less than one per cent of our engineering graduates have left Canada on graduation, that is less than one per cent of those that have entered industries. We are quite proud of this fact. In fact, the actual figure is .7 per cent of our graduates entering industry have left Canada. The rest have found themselves in positions within Canadian industry, with the exception of about 25 per cent who have gone on to post-graduate work either at Waterloo or at other universities; in many cases, at other Canadian universities.

The Chairman: I know that there are still several questions to be asked. Unfortunately, I have an appointment at 5.30, and cannot continue as chairman. I hope you will excuse me. I will now ask Senator Cameron, the Vice-Chairman of the committee, to take over on my behalf.

Thank you very much, indeed, and I hope I will be able to see as many of you as possible tomorrow afternoon.

The Acting Chairman (Senator Cameron): Just to reassure the university representatives here, I think I can speak for my colleagues on the Senate committee when I say we are position for a moment. In the opinion of your-questions, because this is a vitally important exercise. We are taking it very seriously and we want to get all the advice and information we can get.

I should like to come back to you, Dr. Holmes, if I may trespass on this elevated position for a moment. In the opinion of yourself and your colleagues at Waterloo University, has this been a successful experiment?

Dr. Holmes: Yes, senator, this has been very successful. We started with 74 students about 12 years ago on a co-operative program, and it has grown to the present size of

2,400 in engineering, and we now have an intake of 600 to 650 freshmen engineers every year.

We were able to place every single one of them this summer, despite the difficulties that seem to be arising with respect to student vacation employment. Every single one of our students going out on a work term was placed.

We are very pleased with the system. We are pleased with the effect it has on the undergraduates. It also helps to bring some of the problems of the industry back into the classroom. Moreover, the students now have an appreciation of the industrial problems and the industrial scene and understand the opportunities available to them in Canadian industry.

We have in conjunction with the co-operative program an industrial advisory council which meets twice a year at the university largely to advise on the operation of the co-operative program.

One of the reasons for the success of the program is the fact that we have put a reasonable amount of resources into a department of co-ordination and placement, which supervises the students in conjunction with the co-operative program. We have co-ordinators who visit the companies and visit the students out on the work term. These co-ordinators are spread across Canada. They are not just located in Waterloo. They come back to Waterloo two or three times a term to report in, but most of the time they are out visiting students and companies and establishing relationships with industry.

We are very pleased with the system, and a testimony to this is that we have continued its operation; we have not instituted a conventional program but have stuck with the co-operative program, and Canadian industry and government institutions are continuing to cooperate with us most enthusiastically. The contacts made with industry through the undergraduate involvement are also leading to more contact at the graduate and research levels, particularly through our Industrial Research Institute.

The Acting Chairman: There are a lot of very good engineering schools in Ontario. Are there any other engineering schools following a similar program?

Dr. Robinson: If you are asking me, Mr. Chairman, I don't know of any others.

The Acting Chairman: If not, why not?

Dr. Holmes: Outside Ontario, the University of Sherbrooke has embarked upon a co-operative program, and I think they are adopting a very similar pattern to the University of Waterloo. In fact, the terms have been dovetailed so that any company could take Sherbrooke students or Waterloo students, or pair them, and there are all sorts of arrangements like that possible. Another university about to embark on this scheme is Memorial University in Newfoundland. So far as I know these are the only universities presently engaged in such programs.

The Acting Chairman: Is there any significance in the fact that these are all among the smaller universities?

Dr. Holmes: Well, as to that, I think we have the largest engineering undergraduate enrolment in Canada at the present time. Certainly, we are about the same size as Toronto.

The Acting Chairman: I meant in terms of the total university. In that respect yours is still a relatively small and new university.

Senator Kinnear: What is the total enrolment of Waterloo University?

Dr. Holmes: The enrolment is 9,000.

Dr. Schiff: That is hardly small.

Senator Carter: I should like to come back to the engineering statistics, Mr. Chairman. I think that Dr. Cormack said earlier that the ratio for Canada, compared to Sweden and the United States, was 7 for Canada, 22 for Sweden and 27 for the United States. Was that the ratio of engineers you were producing?

Dr. Cormack: These are the numbers of qualified engineers in these three countries for the years 1963-64. This was in a report prepared for the Privy Council office. I don't have the latest figures, I am sorry to say.

Senator Carter: What was that based on? Was it per thousand?

Dr. Cormack: Per ten thousand.

Senator Carter: Is the enrolment in the arts, then, increasing in Canadian universities? Apparently we are not holding our own on the engineering side. What is happening on the other side? Are there more students enrolled in arts now?

Dr. Riordon: We found in Carleton University that the increase in the past year or so in arts, that is, the increase of new students, has exceeded that of engineering quite considerably. I am not sure of the exact figures, but it is a matter of something like 14 per cent versus 7 or 8 per cent.

Dr. Slater: Let me just put this in perspective. The first thing we do in Canadian-American comparisons is to recognize that we have a very much smaller population of people with university degrees of any kind than the United States. That goes for arts, business administration, engineering and all other fields of study. So that in terms of Canadian-American comparisons, we have got to take that into account. I am not saying that we may not have an underdevelopment of work in engineering; we may well have; but we also may well have an underdevelopment of work in business administration and other fields, too.

If we were to make a similar comparison, I think a Swedish-Canadian comparison is something to be taken very much more seriously than the Canada-U.S. comparison, because they are similar in industrial and urban areas and in richness. Indeed, they are a much smaller country, as we are, and so on. I think that is a much more serious comparison.

Senator Carter: May I come back to this earlier question of what is happening about the number of job openings for engineers in Canadian industry. Are the job openings for Canadian engineers increasing or have they levelled off?

Dr. Cormack: Certainly, they are increasing, because the number of students graduating is increasing every year. But I would say that this years' class is having more difficulty than the classes of the previous three or four years. Now, there are many reasons why. There have been some adverse statements in the press. For example, and this is my personal opinion, publicity has been attached to the "over-supply" statements made by Dr. Schneider. I don't think it has helped the situation very much. I think it is going to discourage some students from going into science and engineering. I think this is a great shame. I came from Sweden to accept the position at Carleton, and there there is the position of oversupply of highly trained and highly educated people, but this does not affect the whole country. All it means is that

the people are in competition for the best jobs and they realize that they must do a good job when they finally get it. I would not accept any conclusions too quickly from the arguments presented by Dr. Schneider. Oversupply is not bad for the country.

Senator Carter: I am wondering whether in producing engineers, and there are many different types of engineers, we need engineers with a research background or engineers trained to utilize the findings of research, that is engineers trained and oriented to innovation in design and not to research.

Dr. Cormack: We must have practical-minded people and we must have people who are cognizant of the country's needs, and this means I would agree with your latter statement. We must have more engineers who are innovative but who are also efficiency and economy minded. I think the pure research engineer or the pure research scientist is a man who is maybe too highly esteemed in Canada relative to the man who is a more practical person—an economy and productive man.

Senator Carter: In your opinion or in the opinion of anyone here, are we achieving a proper balance between these two productions?

Dr. Sherbourne: This has been one of the traditional problems in studies of engineering and the emphasis of science and applied science to engineering. Historically the base of activity arose through physics and chemistry and worked its way into engineering through electrical engineering, chemical engineering and others, and as a result most engineering research has been oriented towards science.

Now this has led to a certain lack in some fields such as design where economy comes in. There are also problems such as transportation which never seemed to fit into the picture of physics, chemistry and derivatives thereof. Other things such as accessibility of social problems, industrialized building in housing, and others were also misfits. This is now being corrected. And this is the trend in NRC granting policies and I am sure we will see some significant changes here. When this happens I feel the challenge of these various activities will lead to the recognition of these activities as being respectable for the post-graduate engineer who is not interested in

applied mathematics or the application of pure mathematics. Now I think we will see some significant changes even in the PhD engineer who thinks in terms of economy, design, innovation and production and in terms in the real use of science and its translation into productivity and wealth.

Senator Grosart: Mr. Chairman, I would like to pose for comment three more or less negatives that appear fairly consistently in the briefs submitted by universities. The first is that there should be federal funding only on basic research in universities. There should be no funding on applied science or developments. Any comment?

The Acting Chairman: I do not think they would agree.

Senator Grosart: I just asked for comment and I suppose silence is as good a comment as any.

Dr. Slater: Well, as long as silence is not interpreted as utter nonsense, I prefer to be silent.

Senator Grosart: Well, you will find it in some of the briefs.

Dr. Slater: Very few of them.

Senator Grosart: Very few of them, I agree, but we cannot assume that a suggestion put forward by several universities should be completely ignored.

The second point I am making is that there appears to be an assumption on the part of the federal government in its policy that for constitutional reasons all funding to universities should be limited to the post-graduate level. That is an assumption, and there is the suggestion that it is a very grave mistake. I am asking now if anybody would care to comment as to the percentage of total federal government funding that in any way facilitates under-graduate research and participation in research, and secondly as to whether this percentage should be lower or should be higher.

The Acting Chairman: Well, who wants to back up the policy?

Dr. Robinson: I certainly agree. Certainly in our own university there is very little impact of federal funding on under-graduate work, but this is a little hard to be dogmatic about because federal funding can increase

technical facilities in ways which could become applicable and related to under-graduate courses. So whereas in the first instance it might not necessarily be for under-graduate work, it could well be in the course of time related to under-graduate work. You have a striking example of this in the computer field where the initial computer expenditure would be primarily for graduate research, but more and more computers are being used in under-graduate instruction. This is the kind of change in emphasis which is quite unpredictable.

Dr. Chagnon: Concerning the comment just made, it is not the policy of some of the granting agencies especially in the humanities and some of the social sciences. The Canada Council, for example, in its answer to the Macdonald Report comes out very strongly with the statement that they are not granting to universities; they are granting to research workers. This creates problems for university administrators because you find out that a chap is going on a trip paid for by the Canada Council just the day before classes are due to open. So the policy of granting only to graduate students or graduate departments is not a general policy of the funding agencies. There is a lack of unanimity and co-ordination among the different agencies.

Senator Grosart: You say it is not a federal policy?

Dr. Chagnon: I said it is not a general policy of all granting agencies at the federal level.

Senator Grosart: But are there agencies granting money for under-graduate research?

Dr. Chagnon: The Canada Council grants only to research workers who may be spending 90 per cent of their time at under-graduate work, but if one of them is doing publishing, say in history or something like that, he may get a grant from the Canada Council.

Senator Grosart: Leaving the Canada Council out of it, because it is to some extent independent of government policy, what about departments or agencies such as NRC?

Dr. Chagnon: I tend to agree with you although some of my comments may fall better in the field of science.

Dr. Schiff: There is a problem of semantics here. I am not sure I understand what you mean by "undergraduate research".

Senator Grosart: I would put it this way. We are talking now about federal funding of research in universities. What I am asking is—and I think my question was clear: To what extent do undergraduates participate in the research so funded?

Dr. Robinson: That is a different question.

Mr. Schiff: Yes, I think that is a different question.

Senator Grosart: Then I am sorry. I followed it up by saying: If that percentage is low, is the constitutional assumption one that should be carried on?

Dr. Slater: There is one fundamental point that has to be made here, and that is that the federal Government, under the shared costs program, is paying 50 per cent of the total operating costs of the universities at this time. Since the bulk of the teaching, research, support with respect to undergraduates is met out of this general operating support, the federal Government is, in fact, paying half the cost of all of the undergraduate activities—research and everything else. It may well be that if you took the proportion of the grants in aid of research from the federal Government granting agencies and departments, and asked what proportion of those are directly going to undergraduate students, hiring them as research assistants and so on, that proportion would not be a large one, but I think it would not be insignificant either, at this stage.

Dr. Rice: There is one thing that confuses me. We get into discussions that can go on ad infinitum about what constitutes basic research and what constitutes applied research. I think this may be standing in the way of some very important issues concerning the science policy of Canada. The debate is an old one, and what to one means fundamental to another means application.

The answer to the question Senator Grosart put, I think, is one that was answered by a professor when I started teaching, who had been my professor as a student, and he said, "One of the things you must do is involve yourself in research, to keep yourself from ossifying, and the only way to be an effective teacher is to be an effective researcher." This was in the "sealing wax and string" era; nevertheless it is true today, and what is done in research has a profound effect on what is done at the undergraduate level, so what is spent by the granting agencies has implications far beyond our wildest dreams.

Senator Grosart: I would agree with you on that. However, Professor Slater tended to narrow my question to direct benefit, and I was hoping somebody would make it clear that if you take in the indirect benefits—research facilities, labs, computers, and so on—the picture is not as grim as that put to us where, in some briefs, the percentage has been put as low as 3 per cent as the total benefit to the undergraduate body.

The third negative question arises from the very spirited suggestion made in more than one brief that there should be no contract funding of research in universities by the federal Government, and that it should all be grants or grants in aid.

The Deputy Chairman: Is there any comment?

Senator Grosart: Is anyone prepared to comment on that?

Dr. Cormack: In our brief we make a plea for an institute system which is sited primarily with universities, to serve the role of an interdisciplinary institute to bring together people like sociologists, mathematicians and engineers to concentrate in one particular field of study. These institutes would become, or you could construe them as being centres of excellence, but the objection we have had in bringing forth this proposal is one of economy for research. I mentioned earlier the computer science work for computer aid learning going on at one university and at NRC. It would be our opinion this is an ideal area for concentration in a research institute, and that there should be many of these research institutes. It would serve the same purpose as that the University of Waterloo program does at the undergraduate level, but it would extend into the graduate level and make it so that graduate students are subjected to the problems the Government has, because the institutes would have people coming in from Government laboratories. It would subject the students to practical problems, because industry would have an interest in them. It would not be fragmentation of effort, but there would be one institute, say, in the Province of Ontario which would do work in this particular field of computer data teaching; and anybody interested in work in that field would know that is where the experts are, and they would not have to communicate with several other universities or federal research departments.

The Deputy Chairman: I think that Dr. Robinson has a comment to make.

Dr. Robinson: I would like to make a comment on the point Senator Grosart has raised. The problem of distinguishing between a grant and a contract has almost disappeared in the United States. The terms of the document, whether you call it one thing or the other, are the important things. We have not quite reached that stage in Canada. The Government departments are frequently restricted in the forms they can use, and I have visited several deputy ministers in this regard, particularly with reference to the use of the word "publishability."

Senator Grosart: You mentioned that in your brief.

Dr. Robinson: It is a critical thing to the departments that are, perhaps, new at the game. I remember one in particular, and there is no harm in mentioning it. The Department of Northern Affairs had a contract for an archaeological dig in the northern part of Ontario where they phrased the document in exactly the same way you would phrase a document if you wanted to have a sewer dug across your yard. They said that they would not be paid unless the job was completed by such-and-such a date, and all the rights and control of the operations were in the hands of the department, and so on. I visited the deputy minister and was received very kindly. I explained the problem of the university, that this was not the sort of document the university would want to accept, and after a little conversation he saw the point and the thing was changed within an hour. I think much of the trouble which is supposed to reside in the notion of a contract can be cleared away in somewhat similar fashion. On the other hand, some departments are more restrictive on this matter of publishability, and the Solicitor General was approached on exactly the same point, and after a full dress rehearsal of the problem, where students were involved and publishability was necessary for a thesis, the problem was narrowed down to one in which the present records could be used, but the names that were involved were to be kept out of the thesis. So, the question of publishability was straightened away without any real difficulty. I do not really believe there is any fundamental difference so long as these points are covered.

Now, a contract under which you have classified work being done is a different thing. I think this is being handled in the universities less and less, and perhaps there are very few such contracts negotiated by Government departments.

Senator Grosart: The objection to the contract seems to be that it involves too much of a mission-oriented project . .

Dr. Robinson: I do not really think this is so. I cited those two examples of where two departments entered into contracts. I do not know what you mean by "mission-oriented", but I think more and more you must accept the fact that the universities must play this role if we are to enter the outer world and get away from the ivory tower concept.

I would agree entirely with you, and that is why I find the recommendation in the Macdonald report of a research agreement somewhat confusing. It did not seem to me to be the kind of thing that would work, because obviously you are going to have many different missions, and the conditions surrounding those missions are going to affect the kind of agreement that will be made with the universities.

Dr. Schiff: I agree that that particular problem could be worked out. It could be handled by this mutual agreement but the work must be publishable as literature. But, I see that there are two other differences between a grant and a contract. Contracts now allow for the payment of overhead, and grants do not. My solution is that the grant also should carry an overhead cost.

The real danger, and the one that always worries us, is in the other aspect of the contract which makes it different from a grant, and that is the inability to use money from a contract to pay academic salaries. This is the so-called soft money problem, and the American universities have got themselves into real trouble on this issue, where you take on a very large staff which is paid on a contract which may or may not be renewed. When the contract falls through after a certain period of time the university is faced with the problem of what to do with those people.

Senator Grosart: This is one place where our constitutional problems would be an advantage. Is it York University that discussed this at some length?

Dr. Schiff: Yes.

Senator Grosart: I think you say that either the federal Government is ignoring the British North America Act, or they should pay more. Is not that what you are saying?

Dr. Schiff: In the brief I think that reference was to the fact that the Medical Research Council allows the payment of professors off the grants.

The Deputy Chairman: A few minutes ago I said that we could sit as long as we wished, but I should like to point out that I have also learned that the mind will absorb only what the seat can endure. We have been sitting here for nearly three hours, and I suspect that the law of diminishing returns is soon going to apply. Some of us were sitting until after 10 o'clock last night, and we were at it again this morning, as we shall be tomorrow morning.

However, before we close this session I should like to ask one question that has been bothering me. Somebody in Canada within the next few months is going to be in the position of being a member of a board of directors concerned with the allocation of \$860 million a year, an amount that will probably be doubled in the next five years. We have been sitting for 15 months and we have had a lot of material thrown at us, but there is one question that has not been answered to my satisfaction, and I throw it out now to the universities with one last desperate cry. We must have some kind of inventory of what is going on in Canada. I do not mean the minutiae of all the different proposals, because that is impossible, but this board of directors must have some overall view of what the \$860 million is being used for. This will include, of course, expenditures by Government departments and the universities, and by private industry. We must have a total picture if we are going to plan ahead and obtain the most effective use from the money we spend, in terms of manpower and in terms of plant and equipment. We have been told time and time again that we cannot have this, but I would hope that the universities, with all their expertise and knowledge, can give us some guidance of what we can do in this area.

Dr. Carroll: We mentioned in our presentation that it is our belief that the maintenance of an inventory such as you have described, and the reporting from it as required by the governing body, is definitely within the state

of the computer art today. I have the utmost confidence that such a system could be developed.

The Deputy Chairman: Thank you. The answer that we have been getting is that it is impossible. We have been getting that answer many times, as my colleagues can tell you.

Dr. W. B. Rice (Queen's University): Does the gentleman mean that we shall have a computer as the board of directors? This is not a frivolous question. I am confused by his answer.

Dr. Carroll: I am simply saying that the information would reside within the computer system, and that the human beings, who are, in fact, the directors, would be able to query the computer system and have delivered to them only the information they require in the form in which they desire it.

Dr. Cormack: I would like to direct a question back to Senator Grosart. Would it not be better that direct research be done by the universities, because it aids in the training of students and also the education of the faculty, rather than having it done by the Government in which case it results, as a primary product, in an increase in the size of its labs?

Senator Grosart: I will say that you will have one-eighteenth of my answer when you have our report. I do not know the answer to that question.

The Deputy Chairman: On behalf of the committee I should like to thank all those who have participated in the discussion this afternoon. We are grateful for the time you have taken to come here, and I hope we shall see some of you tomorrow when we shall conclude the representation of the universities.

The meeting adjourned.

APPENDIX 70

BRIEF
TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

FROM

THE FACULTY OF SCIENCE
YORK UNIVERSITY
TORONTO

Harold I. Schiff
Dean of the Faculty

March, 1969

1: INTRODUCTION:

A small committee representative of the Faculty of Science, York University, was established by the Dean of Science on February 4th, 1969, to prepare a brief to the Special Committee on Science Policy of the Senate of Canada. Having reviewed the terms of reference of the Senate Committee as outlined in Senator Lamontagne's letter of December 20, 1968, to Mr. Howarth, Registrar of York University, our committee decided to consider the matter of Canadian science policy from the point of view of scientifically informed Canadian citizens as well as from the particular interests of university scientists.

In spite of the great deal of discussion on science policy in recent months we wish to express concern about the following:

1. There is still no really informed professional scientific opinion among members of parliament, the cabinet nor the Senate. In addition, the government seems inclined to place little weight on the scientific advice it is given via the existing channels.
2. A great deal of public misconception exists on the nature of scientific endeavour and its related aspects, Research (Pure and Applied) Development, Testing, and their long range implications in industrial production.
3. In North America the whole impact of science on society has been blurred by the sociological considerations of Defence Science and the Vietnam war.
4. The interrelations of the Science-Technology-Industry-Economic complex and their impact on national independence, national growth and national prestige are very complicated and it is a simplistic error to consider any one member of the interrelated sequence separate from the others.

In this brief, we thus summarize in the next section a number of premises on the place science plays in the life of a developed country such as Canada, and in the final section we make a number of specific suggestions for Canadian Science and Science Policy.

2: PREMISES

The following comments are, we hope, self-evident statements on the place of science in the operation of Canadian society and are the basic assumptions in terms of which the recommendations of the next section are made.

Scientific activity in any developed country is carried out in many ways for many reasons under the auspices of many agencies, and in the end much of it is paid for from public funds of one sort or another. Activity in science is thus a matter of public interest and concern. A "developed country" is, more than anything else, a technologically developed country. This implies that it has the sophisticated and interrelated means of communication, transport, power distribution, health services, primary and secondary consumer manufacturers industry, defence capability, etc.

To maintain and develop this pattern of activity which adds to economic growth of a nation and to its influence in world affairs, the technological base on which all activities depend must be nourished. One recognizes the closely related technological activity chain:-

Discovery - Innovation - Development-Manufacture and Testing-Marketin
(Pure research) (Applied research)

Any technically self-reliant, developed country must have the potential to maintain a significant level of effort in all aspects of this technological activity chain.

In most "developed countries" (eg. Japan, Sweden, Holland, UK, Germany, France, US, etc.)

Discovery (research) is carried out in University, Government and Industrial (both profit and non-profit) laboratories.

Innovation (applied research) is also carried out in University, Government and Industrial laboratories, with a different distribution of priorities.

Development is mainly carried out in Industry and Government laboratories.

Manufacture and testing is mainly carried out in Industrial laboratories.

In Canada, however, we are technologically dominated by Europe and the United States from whom we purchase the already developed technology to support our "branch-office" manufacturing industries, and our armed services. This state of affairs has profound effect on the character of our way of life and economic thinking and to some extent makes a mockery of the idea that Canada is an independent country. This is seen most clearly by the effect that importing technology has on any research activities in industry, where research is almost non-existent.

From the short-range day-to-day standpoint of profitability of Canadian industry, particularly for the responsibility to shareholders, the absolute dependence on the U.S. and Europe for purchased technology is economically sound. Satisfying profits are made and a high standard of sheltered living is

maintained. It is not often realized by the average citizen however, how great our dependence on other countries is. To take a very small example, almost none of the equipment in the York science laboratories was manufactured in Canada. We just don't have the technology to do it. The automobile industry is another good case-in-point. Here we have reached an agreement which, although it ensures the "production" end of the R & D spectrum, prevents Canada from ever doing any true research or development in this area. Perhaps, however, a population of 21 million in so large a country should not aspire to be independent or to have so high a standard of living as we have.

On the other hand, Canadian pure science is strongly nurtured in university and government laboratories including those which have taken on a "National Laboratory" status. In fact universities are the only institutions which have a substantial commitment to prosecute basic research. This is a very healthy state of affairs on which some recommendations are made later. Canada has a good reputation for pure science which should not be thrown away by a naive over-reaction to demands for hasty re-allocation of funds and priorities to more applied work.

Most of the above facts have been recognized both inside and outside government but we are apprehensive of an unsophisticated overreaction (as for example in Mr. Drury's recent comments) that "Canadian science must be moulded to suit the economic needs of the country", and that finances must be re-allocated to emphasize applied and industrial science. This is, of course, a politically acceptable posture and one with which we are in general agreement. However, there is a danger that such statements can engender a much too simple-minded response to a complex multi-factor situation. A major diversion of research funds to an uncertain industry or to unprepared university teams to stimulate

applied research could easily weaken the existing science activity which Canada has developed over several decades and for which she has rightfully earned an outstanding reputation in the outside world. A science policy decision which concentrates solely on one aspect of science activity without due regard for the others could bankrupt us technologically.

Insofar as the universities are concerned, their role from a scientific standpoint (as well as for other disciplines) is essentially composed of two complementary but often competing activities:

1. Aiding students to learn about the existing state of man's knowledge in specific fields or disciplines, (an activity centred most strongly in the undergraduate program).
2. Aiding students to work with the faculty to extend the frontiers of man's knowledge through research and advanced study, (an activity more strongly associated with programs at the post-graduate level).

These two activities are closely interwoven in the fabric of all universities but their separate existence as well as the specific requirements of each must be recognized. This is most important, since often suggestions to optimize one role tend to conflict with the requirements of the other. Both areas are, obviously, absolutely essential to any meaningful science policy in Canada. This is made more apparent when one considers that, in most cases, the same faculty members share these efforts on both activities.

Some have suggested a separation of these two roles, but in science we feel that this step should be avoided. There is much to be gained by having faculty and students interacting at all levels. However, this interaction involves a rather delicate balance which could be easily disturbed by abrupt changes in either the educational or research policies of the governments.

Since these two activities presently are being controlled somewhat independently at the provincial and federal levels, there is a real need for increased co-operation.

In addition, the university research activity is not only a vehicle for post-graduate education, it is also an important aspect of national progress and prestige in science. Because of past efforts Canada has a good international scientific record. Pure research is relatively inexpensive and is best done by "whim". It is an exercise of the imagination and cannot easily be structured by mission-oriented statements dictated by non-scientists, for such decisions are often made on the basis of short range economic criteria. Overconstrain the system and the many able minds will leave or will never mature. The catastrophic effects of major and rapid diversion of research funds can be seen in recent U.S. experience.

It is falacious economic exercise to attempt to draw far-reaching conclusions about the number of non-Ontario (or non-Canadian) graduate students in our graduate schools and the cost of educating them. One has to consider such data in terms of how much Canada draws from the bank of international scientific knowledge and how many people who currently contribute to Canadian science were born and educated outside the country. For some years Canadian scientists have been recipients of significant amounts of U.S. research supports funds.

Insofar as government science is concerned, it too has both pure and applied facets to its work appropriate to the departments concerned. A number of government departments have developed national laboratories of world rank. Any move to disrupt these would be folly. Any serious moves to

reduce markedly the pure research in government laboratories will leave them staffed with second rate personnel. The imaginative people will leave if their working conditions are seriously disturbed. The drift of good government scientists to the universities during the past few years is an index of this.

National laboratories of world stature now exist in Canada. They should be strengthened. Examples are NRC, Astronomical Observatories, Churchill Research Range, AECL, etc.

Insofar as industrial science and development is concerned, it is largely non-existent because of the overcaution of industry, the domination by U.S. and European head offices and the importation of technology referred to above. (There are a few notable exceptions to this, but compared to other developed countries the statement is true). As a result Canadian scientific effort is unbalanced and the human products of science programs at its universities do not have a strong employment prospect in the industrial area of technical activity.

It is fallacious to assert that we are overproducing Ph.D's. We are under-employing them. They cannot expect many job prospects in Canadian industry.

3: RECOMMENDATIONS

In this section the recommendations for developments in Canadian science activity (which could be implemented in a government science policy) are made.

SCIENCE AND GOVERNMENT

Serious consideration should be given to unifying and coordinating the government's present activities in science and technology under a responsible authority whose major responsibility would be to keep a watching

brief on all aspects of Canadian science and technological activity and to administer funds for it, and to advise the government on such matters. We recognize the problems in implementing such a proposal but the need for improved coordination is urgent. The responsible authority need not be a single individual or committee, provided sufficient power to implement decisions rests with this body.

A most important desideratum is to educate MP's, cabinet members and government of the impact of science and technology on the life of a 20th century industrial society. The present laissez-faire attitude and apparent apathy towards science is, frankly, frightening. Lack of scientific awareness on the part of legislators is understandable when one considers that few scientists enter the political arena. Can scientists be encouraged to enter public life?

Annual budgeting and related uncertainties of all research greatly limits the overall productivity. Serious consideration should thus be given to the 2-year or 3-year funding of serious scientific projects in government, industry and the universities. The proportion of unproductive time spent on budgetary exercises would thereby be greatly reduced.

Federal and provincial government laboratories should have clearly defined missions, the interpretation and the implementation of which should be fairly flexible so that the most appropriate blend of pure and applied work for the job at hand can be adopted in the relevant research programs. Change should not be caused just for the sake of changing things, or for the sake of short-term expediency.

Many government laboratories and installations (eg. some NRC

labs, AECL, Chalk River, The Churchill Research Range, the National Astronomical, including Radio-Astronomical, Observatories) have through sustained work of world quality justly gained the reputation as National Laboratories and are important national resources. They should be encouraged, and the use of such laboratories (which should continue to be well-equipped) by the community of science at large in Canada should be formalized. In most of the laboratories non-staff guest researchers from elsewhere have, on request, in specific circumstances, been given generous opportunities to use the facilities. This has been through the thoughtfulness of their colleagues in the laboratories who make the informal arrangements. Any short-sighted move to re-orient all of these government laboratories towards industrial-oriented applied work would be nothing short of madness. It is in these laboratories that much of the first rate science for which Canada has received international acclaim has been forged.

SCIENCE AND INDUSTRY

In spite of much public and private debate, Canadian industry has in many instances understandably been reluctant to set up its own first class research laboratories for many companies and corporations just cannot afford to undertake the expense. They are often controlled by U.S. or European parent companies from whom the necessary technology for a parasitic copying of the parent's products will suffice. Canada, nevertheless, has a unique geographical, mineral and economic situation for it to develop industries of its own if it has its own self-sustaining technology in say:

- Pulp and Paper
- Metallurgy and Mining
- Applied Optics
- Electronics and Communications
- Aerospace Engineering
- Operational Research

Computers
Agriculture
Drugs
Petrochemicals
Geophysical Prospecting
Transport
Defence
Arctic Exploitation
Pollution

One way in which basic and applied research in these areas could be set up to provide a Canadian technological base for its industries is to encourage the formation of a number of research institutes (one in each appropriate technological area). The mission of each would be to be a national repository for information and technology development in the appropriate area. Each would be staffed by one to two hundred professionals and could viably be financed if each industry, which would profit by access to the work of the institute, contributed a significant annual membership fee which could be diverted from corporate income tax. Companies could also set up their own laboratories for proprietary research as necessary, but the mainspring of technology in Canada could be fostered in the research institutes. They would also provide a much needed pool of challenging career positions for the products of Canadian schools in pure and applied science.

Encouragement should be given (by suitable financial incentives) to the development of small "idea" firms such as prosper around highway 128 in Boston or in the San Francisco Bay area. These are small, innovative firms which provide scientific and technological services of a very special kind and can draw on a great strength of university scientists as consultants. Many of the U.S. examples of these have been able to survive by the use of the "study contract" by the Department of Defence in the U.S.

These are only a few specific examples of how we could start to

tackle the major problem of Canada's lack of scientific and technological involvements in industry.

SCIENCE AND UNIVERSITIES

The universities should continue to be accepted by Federal and Provincial Governments as the most important source of pure science in the country. The Provincial operating and capital budgets (mainly for undergraduate education) and the Federally supplied research budgets should reflect this, and not just be a sop for professors to play at research in their spare time. In this respect any major move to divert to the provinces the responsibility for funding scientific research should be resisted firmly as the temptation to use such funds for other more general purposes will be hard to resist by university financial officers.

Research in universities should, of course, be the vehicle for post-graduate and post-doctoral education and training. In this respect much more cooperation between universities and non-university laboratories is needed. Well equipped non-university laboratories should provide the possibility for M.Sc. and Ph.D. level research provided reasonable arrangements can be worked out with the graduate schools. The traditional insularity of the graduate schools has to be removed. A number of universities have already moved in that direction.

Insofar as the funding of research is concerned, the administrative procedures associated with annual research grants is extremely time-consuming to the detriment of the programs concerned. Much time is taken up in planning for, applying in and reporting on research. Longer term research grants are very much to be recommended. Similarly, while the adequate support of individuals should never be removed, excellence should always be supported,

and on-going research centres should receive consolidated funds for the persecution of well-conceived programs.

Professors should be encouraged to cooperate with each other within and across departments much more, to share capital equipment, and to use the facilities of national laboratories where necessary. The need for adequate computer facilities cannot be too strongly stressed.

As far as it is able, the National Research Council does a very fine job, not only in its own laboratories, but in the distribution of research grants.

There seems to be a number of anomalies when one compares the operation of the Medical Research Council and the National Research Council with respect to the administration of research support. In this day and age, when much significant life science research can be, and is being, done in pure science departments, as well as in medical schools, it seems to be anachronistic that MRC should nearly always support only faculty who have a medical school appointment. Basic researchers in medical sciences who work in Biology, Chemistry or Physics Departments should also equally qualify for MRC support. It is also anachronistic that in a number of medical schools a number of senior tenured faculty members of associate professor and full professor rank should have a large fraction of their salary paid by MRC fellowships. This is either contrary to the BNA Act, or should apply equally well to researchers in pure science departments. Possibly the recent transfer of responsibility for MRC to the Department of Health and Welfare will change its character.

Is there really a need for a separate MRC, NRC (and we hear) and Engineering Research Council? This seems to be a fragmentary move. It would seem that one science body would far better administer the federal support of scientific research to Canadian universities.

APPENDIX 71

WRITTEN STATEMENT TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

by

Dr. John Hart
Dean of Science
Lakehead University
Port Arthur, Ontario.

INTRODUCTION

This statement is divided into three sections:-

- 1) The Difficulty of Getting Started,
- 2) The Necessity for More Applied Science,
- 3) The Need for Education in the Socail Effects of Science, Technology and Technique.

Dr. Hart was for four years a research worker in the Division of Applied Physics of the National Research Council of Canada. He subsequently saw the University grow from a tiny downtown college to a fine institution with a first class physics department housed in its own building. He subsequently went to Brock University where he was responsible for the academic development of the first year of operation, and he has been Dean of Science at Lakehead University for three and one half years, during which time the Faculty of Science and the University Schools have grown by at least one order of magnitude and are now housed in a fine teaching and research building. Dr. Hart is an expert in electrical insulation and has chaired several Canadian and international committees in this discipline.

THE DIFFICULTY OF GETTING STARTED

It is difficult to get started. This is true for a new institution and for a new scientist.

New Universities have always faced the problem of reactions from within. In all three universities in which I have been privileged to serve, there have been reactionaries who wanted to see the institution stay as a small cosy structure providing a pleasant quiet life for its faculty. However, such reaction is always overcome, and by and large, the senates of the newer institutions recognize that the function of the university is both to transmit knowledge and wisdom and to discover or to assist others in discovering, new truths. But in the past two years new dimensions have been added, and the universities find themselves fighting for their rights against external bodies. The idea of university autonomy is increasingly regarded with suspicion by provincial governments, and the role of the interaction between teaching and research is not well understood. The universities have, perhaps, not helped this situation by, in some cases, their so-called publish or perish policy, which has resulted in the neglect of undergraduate teaching. Perhaps I should make the point that the small newer institutions devote far more professorial time to undergraduate teaching than the larger institutions. It is usual in the smaller universities for the professorial staff to lecture to first year classes, conduct seminars and laboratories--this is certainly not so in some of the larger institutions where the first year classes are delegated to teaching assistants and graduate students!

The research function is necessary to a university because without the continuous challenge of the research laboratory, a scientist ceases to be a scientist and becomes a conveyor of dull facts. The further point could be made--that if all research were carried out in nonteaching institutions, there would be no passage by which the expertise of the scientists could be conveyed to the younger generation, and what a tragic loss that would be.

The superficial attitude toward universities which is widely prevalent outside them is exemplified by the 'Special Study Number 8' of the Science Council of Canada. The introduction to this study states very clearly that it is a personal statement of the views of the Committee and J. P. I. Tyas, but nevertheless, it is published as a Science Council of Canada document and as such must be supposed to have some authority. In Appendix (e) on page 49, it is stated that "The primary function of the university is to teach.". The appendix then goes on to state that "Universities...must specialize on teaching, if necessary

at the expense of inhouse research...". The paradox inherent in this statement, however, emerges in the next paragraph where it is stated that "In the long run, the knowledge emanating from universities that will be most beneficial to society will...be...in the minds of graduates who go forth to work in society...". It is not made clear in the appendix how knowledge can emanate from universities if the university faculty is not to indulge in research.

Most university scientists take it as self-evident that a faculty of science must have a research function. Now the methods by which this research function can be achieved are various. There are such devices as research institutes, which I shall mention later, whose function is wholly devoted to research, with the faculty members tending to have their primary responsibility to the institute rather than to teaching. However, I think that most deans would say that in forming a faculty they have to balance these functions as best they can. They will do this by hiring faculty members who are primarily teachers, faculty members who are primarily research workers, and they will hope to obtain the rare paragon who is a mixture of both. A wise dean or departmental chairman will tend to encourage those who are good at teaching to teach and those who are good at research to conduct research, but they will take care that the majority of the faculty members do, in fact, have a foot in both camps. This is a practical and humane policy. The newer institutions are bringing into, or are acting as the vehicle for the return to Canada of some spectacular talent. In our own institution, the Faculty of Science has among it, at least, ten faculty members with international reputations in their specialities. Most of these people, of whom roughly one half are Canadians, would not have been in the country were it not for the existence of Lakehead University. Our national science policy should make sure that these people are fully supported, particularly during the formative years of the institution. They should be given every encouragement to develop groups within their research expertise, and if they can be persuaded to undertake research which is of obvious direct benefit to Canada, so much the better. It is my contention that this support is not forthcoming because of the restrictive policies of the granting bodies, and the failure of the scientific establishment to recognize that by hard work and a certain amount of luck, a first class group of research workers can exist in a place where previously there was nothing.

The days of string and sealing wax seem to be past. In order to establish a reasonable research facility, it is necessary to first establish the instrumentation that is vital to the work to be carried out. However, the granting procedures of the National Research Council militate against the formation of such a foundation.

Perhaps I should digress at this point to state that the use of expensive scientific equipment in research laboratories is not usually very efficient. In the Ottawa district, there are certain federal government laboratories where most expensive pieces of equipment, bought by one research worker or a group of research workers, stay idle for weeks on end. However, with the granting policy of the National Research Council, it is evident that major equipment grants are normally made to one person or a small group of people working in a single discipline. This means that the prior development of a facility with a view to attracting people into a research group is impossible. In our particular case, for example, we have developed an instrumentation facility worth, at an approximate guess, some \$500,000. We have not once had a National Research Council grant for this facility, and the only interdisciplinary money of any kind that we have received is the \$25,000. annually that goes into the National Research Council's University Presidents' Fund. This fund is normally used to supplement National Research Council grants where they have proved to be grossly inadequate for the work already in hand, such as in our Department of Mathematics, where almost all applications for money were rejected. Certainly nothing is left over for the starting of an interdisciplinary research group of any kind.

The point is, that the National Research Council granting procedures are not well co-ordinated, and, as I understand it, the grants are awarded within individual disciplinary areas. This makes it very difficult for work in an interdisciplinary field to be developed and the potential of a new university where departmental interests have not been allowed to develop, is greatly reduced.

At Lakehead University, our contact with the granting structure of NRC has been restricted to the visit of two administrators who came at our invitation some eighteen months ago, and one chemist who is a member of the National Research Council, and who had more than one reason for visiting the Lakehead. There is both at Lakehead University and elsewhere a great lack of understanding of the means by which grants are determined and there is some resentment that the purposes for which grants are requested are often not understood by the granting body. We also feel that the granting body does not usually have enough information on which to base its recommendations, and the whole procedure needs to be thoroughly overhauled. In particular, we cannot understand how the National Research Council could determine on the basis of one annual report unsupported by a referee, what the progress of research has been. One is, therefore, led to the conclusion that the National Research Council must base its policy on publication, and this of all things is most detrimental to university work, and has already led, in many

Canadian universities, to the much deplored 'publish or perish' policy. We do not have such a policy at Lakehead University, and we do not wish to have such a policy, but we do wish to pursue research of benefit to the Canadian economy. We do not believe that the present granting system is adequate for this purpose. Lest I be misunderstood, let me hasten to add that it is not the amount of the grants that concern us, at this time, but the method of allocating them. We all recognise that there is a limit to the amount of research support a new university can expect to have.

No doubt most of these points can be answered by the National Research Council, but the point is, surely, that it should not be necessary for us to feel this way. We have enough difficulties with bodies other than the federal government in getting our research underway, and the lack of information that we have, or at least the feeling that we have a lack of information, is not good for our morale.

Finally, in this section in discussing the difficulty of getting started, I would like to talk for a moment about the young research scientist. There is no doubt that a brilliant man will, unless some disaster happens in his personal life, get underway very fast at an early age and will succeed in establishing his field very quickly. For such a man the assistance comes from one source or another and he will be given the facilities that he needs. However, I think that the Canadian policy towards not-so-brilliant research workers when they first start out should be revised.

It used to be Dr. Steacie's dictum that a scientist should be as far as possible left on his own to do what he does best. Whether that policy still holds in the National Research Council, I cannot say. However, from the granting structure, it appears that something like this policy must be followed, since most new research workers receive a grant for them to undertake independent research. I would like to challenge this policy, and if I may, call on my personal experience. When I first started to work at the National Research Council, I recognised full well that I was not and was unlikely to become a brilliant research worker but I was perfectly prepared and, I think, was competent to work in the general field of applied physics. However, in the Division of Applied Physics, at that time, there was no direction whatever given to young men and I started to gallop off in all directions. I started some work in dielectrics, I interested myself in the development of AC standards and meter calibrations, and I undertook to wind one of the Canadian standard inductors. This was far too big a task for a young man, and I became frustrated and left the Council. I see

the same thing happening in other young men, both within and outside government research laboratories. I believe that the government should give a lead in helping these young men to restrict their activities. There are several ways in which this could be achieved, and one of them, which seems so obvious, that I cannot understand why the practice is not followed, would be to give some feedback to the grant recipient. In other words, if a grant is refused or reduced, or even if it is awarded in the full amount, there should be some statement with it concerning the National Research Council's view of the direction of the research. The lack of feedback from this granting system is a prime example of lack of communication and indeed of an opportunity to strongly influence the goals of research which, after all, is financed out of public money, a fact that is sometimes forgotten by the research workers concerned. In addition, I believe that funds should be made available to research group leaders or departmental chairmen so that they can, at least, influence their younger people to work in small groups. Immediately, the suggestion is made, the specter of the control of an individual research worker's freedom is raised. I believe that we have to face up to the fact that if we are to continue to develop our science this freedom has to be restricted both in government laboratories and in universities. In other words, in a university there may be nothing to prevent a research worker investigating a particular field, but he would have to find his own money to do it. I think the dangers are grossly exaggerated particularly in the minds of some of the nonscientific members of university senates. I believe that if Canada as a whole paid more attention to the training of young scientists during their early years of independent research (in other words, at the post-doctoral level) the scientific strength of the country would be greatly enhanced.

Finally, I would like to agree with the minority report of Dr. L. P. Dugal in the Special Study Number 7, commonly called the 'Macdonald Report' prepared for the Science Council of Canada and the Canada Council. Dr. Dugal appears to predicate his minority report on the problems of French Canada, but I would like to reassure him that English speaking universities do have the same problem. The policy of granting awards, which must be based on the criterion of excellence, is not a realistic policy because of the rapidity with which the country is growing. I believe that there is a strong possibility of the provincial and federal governments acting as true partners in the support of research, a facet of the problem that I shall mention in the second part of this statement. The Macdonald Report and the recommendations appear to me to be very much a report by the establishment.

In addition to agreeing in general with the minority report, I would also like to make a statement about recommendation 26 of the Macdonald Report, namely, that the federal government undertake a comprehensive study of the conditions under which government employees may teach in universities. It is my experience that government employees often desperately want to teach. Perhaps, there is a very deep seated reason for this--they feel a responsibility to passing on the expertise earned during the course of their employment. If this is so, then surely the solution is to reexamine the whole nature of government research laboratories. Often, the availability of government workers to lecture in university courses does not strengthen the university but weakens it because the government employees who come in as part-time lecturers really have no stake in the university. The desire to teach is something that should be capitalized on, and it may be that the honourable Senators may wish to examine whether the research that is at present carried out in government laboratories, could not, at least as effectively, be carried out in universities. Alternatively, there is a case to be made, perhaps, for developing extramural campuses under joint provincial-federal support. The Atomic Energy of Canada Limited installation at Chalk River would have a real shot in the arm if some of the arrangements that AECL makes with individual universities were codified to the point where AECL became a branch campus with much the same relationship to the main campus of some university not dissimilar from the relationship of the Institute of Aerospace to the University of Toronto. I do not wish to unduly stress this point--all I am trying to convey is the idea that some highly skilled teaching talent is being misused, or, at least, wasted, and that is to the detriment of the scientific development of the nation, surely? This point is made in the Special Study Number 2 of the Science Secretariat in appendix e on page 379, but has received too little attention subsequently.

THE NECESSITY FOR MORE APPLIED SCIENCE

In Special Study Number 2 prepared for the Science Secretariat by a study group of the Canadian Association of Physicists, the first and strongest recommendation is that special consideration should be given to the strengthening of the research effort in applied physics. It was not in the terms of reference of the study group, but I would suggest that in Canada at the present time a major research effort should not just go to applied physics, but to applied science in general, with particular reference or particular emphasis to interdisciplinary applied problems. As I said at the beginning of this report, my area of expertise is electrical insulation. I have been working in the field for some twenty years. Among other activities, I have until recently been chairman of a committee of the National Electrical Manufacturers Association in this field, I have been chairman of the National Research Council Committee on Electrical Insulation, the Canadian Standards Association Committee on Electrical Insulation, and I have also attended an International Electro-Technical Commission Meeting as a Canadian representative on electrical insulation. The exact statistics on the annual production on electrical insulation are not available because it is not a very clearly defined product, but it is known to be a billion dollar industry. Canada has three of the prime resources for the production of electrical insulation--wood, alumina, and petroleum products. Electrical insulation cannot be said to be a popular subject, but there is a small corps of experts in the field, and the Institute of Electrical and Electronic Engineers has recently formed such a group in Canada which met in Ottawa yesterday.

One of the recommendations of the NRC Committee was that federal support should be put into the development of a research project in a pulp and paper field with a view to developing good Canadian paper insulation. A great deal of effort went into the Committee and its recommendations were, I think I can say without exaggeration, turned down flat by the National Research Council. At that time, the new National Research Council policy on industrial research was being implemented and the inference was that the new program would take care of proposals of that kind. Now, in fact, despite repeated stirrings on the subject by the people interested, absolutely nothing happened and no assistance of any kind was forthcoming. Government alone is not to be blamed for the situation. About three years ago, the President of one of the biggest paper manufacturing companies in the country deplored the lack of applied research in universities. I wrote to him and offered to put the facilities of the university at his disposal to solve any problem that he wished to name. He did not even reply to my letter.

There are two paper mills in Canada that are now turning high grade electrical pulp, one in the Province of Quebec, and one at Dryden,

Ontario. By dint of a great deal of effort, we have now started an extremely small research project on electrical insulation in co-operation with the Dryden Paper Company. Almost all the resources for this project have come from internal university funds, and we have purchased some \$50,000. worth of apparatus specifically for the project. The Province of Ontario has provided us with \$3,500. for the project, a very welcome indication of the province's policy in the support of applied research. Last summer, I tried to sell this project in the National Research Council, the Department of Industry, and several other government departments. It turned out that for one reason or another, the arrangement that we wanted to make which was that the research would be done in the university laboratory with the co-operation of the Dryden Paper Company, did not qualify for federal support of any kind. Further, when I applied for my National Research Council grant this year, I stated that I was going to work on this project as opposed to the more pure projects in the past. The grant awarded to me this year is the lowest that I have ever received, and I shall be hard put to it to find the necessary staffing assistance to carry on the project. It may well be that the National Research Council has decided that my research record, whatever the project that I shall follow, does not justify the granting to me of money. If that is so, I would like to know. However, on switching to applied research, my grant has been cut, and since I was active last year, the only conclusion that I can draw is that the particular granting committee within the National Research Council that examined my grant was prejudiced against research in the field of electrical insulation. I would like to make the further point, that by virtue of the method of applying for the grant, I have no doubt that my request went to a committee of physicists: it would have been much more appropriate for it to have gone to a committee of physicists, chemists, and electrical engineers, who really understood the magnitude of the problems that have to be tackled in the field of electrical insulation. I would like to add one final statement about applied research. There is a great deal of suspicion in university senates about the orientation of applied research, particularly when it involves industrial secrecy. I believe that quite often manufacturing companies (I am not referring to the Dryden Paper Company here) are unduly jealous of their trade secrets. University senates are very reluctant to make arrangements for students to undertake secret theses. It occurs to me that my above remarks might be misconstrued. I would like to make it quite clear that we are grateful to the Government of Ontario and the Dryden Paper Company for the co-operation that they are giving us.

One final aspect of the applied research problem concerns industrial research institutes. The directors of these institutes can speak, no doubt, for themselves, but it appears to me that they are not having the success that they fully deserve. This is a pity, because in some universities the formation of the institutes has been a genuine

attempt to make the university of direct community service. There is already enough suspicion among university faculty members of such institutes, as I said in my first section, because they appear to control an individual faculty member's freedom, and to some extent this is true. Unless industry can in some way be persuaded to make use of these institutes, the often heard criticism that the universities do not co-operate with industry will surely have to be replaced by the criticism of industry that it is not co-operating with the universities.

THE NEED FOR EDUCATION IN THE SOCIAL EFFECTS OF SCIENCE,
TECHNOLOGY AND TECHNIQUE

For the past seven or eight years I have taught a course to nonscience students about "what science really is?" and the social effects of science. This course is wide-ranging in nature, and covers everything from Galileo through to pollution, birth control, overpopulation, the effect of technique, including business administration and computer technique, upon our society.

From time to time we have visiting scientists come to that course from government or industry, and these visiting scientists attempt to put their point of view to the students. The students come into the course with a strange enough idea of what science is, and I must say that with a few notable exceptions, the visit of professional scientists does nothing to dispel their fears.

At the time of the controversy about the intense neutron generator we became interested in the matter as a class project, and we invited one of Canada's most eminent scientists to visit us. It is difficult for me to criticise so eminent a man in public, but the fact is that his statements about the intense neutron generator simply confirmed in the young people the fears that they had of vast quantities of money disappearing into the voracious jaws of an uncontrollable organization devoted to the narrow pursuit of the agrandissement of science. This, of course, is not what the purpose of ING is, but the fact is, that the suspicion of such projects, however worthy they may be, is not recognized by scientists as being a factor in decisions made concerning their research. I would go further and say that the whole development of what Blilul calls "technique" is what is basically causing our national difficulties—for that matter, our worldwide difficulties, and the Science Council would do well to devote a considerable part of its effort to a study of the apparent arrogance of scientists and the inevitability of technique. We are in the grip of a technology which we cannot reverse and there are already strong signs that it is beginning to control us. I think Canada is very well situated, as a relatively underdeveloped country which, nevertheless, has a high level of technology, to examine the problem dispassionately and to perhaps come to some understanding of the problem that may be useful to the whole world. There are some people in the Science Secretariat who appear to have the time and the patience to start an examination of these problems and they should be encouraged. In addition, the granting policy of either the National Research Council or the Provincial Governments should be changed to make research in this field a possible activity for practicing scientists, and every encouragement should

be given at all levels of education to teachers who want to convey to their students some idea of the magnitude of the problems that we face because of our technical world. I do not mean by this that school teachers should abandon a study of science per se but that they should be encouraged to understand that the technique of science is not science itself. This cannot happen until there is a marked change in the attitudes of the provincial departments of education and the universities themselves. The problem is truly one of education as opposed to training, and although constitutionally the federal government might feel itself on somewhat shaky ground in attempting to tackle this problem, it has to be done, and fast. I would recommend most strongly to the honourable Senators that in their report that they give some encouragement for the establishment of a working group to develop this theme.

(Signed)

John Hart,
Dean of Science,
Lakehead University,
Port Arthur, Ontario.

APPENDIX 72

BRIEF TO THE SPECIAL COMMITTEE OF
THE SENATE OF CANADA ON SCIENCE POLICY

University of Waterloo
Waterloo,
Ontario
Canada.

Summary and Recommendations:I. SUMMARY

The role of the university might be considered as consisting of three inter-related parts, teaching, research and service. Included in these three facets of the university's role is, of course, the storing and organization of knowledge, the generation of new knowledge, and the advisory or consultant activity of the faculty etc. The service role of the university perhaps has been insufficiently acknowledged although it is by no means a new phenomenon (the service to agriculture of the land-grant colleges of the U.S.A. is a prime example). However, much of the research conducted within the universities must be free from the pressures of the relatively short-term requirements of both industry and society in general. Much of the university research is indeed of long-term interest and must not be sacrificed to immediate or short-term needs of society. This long-term, often disinterested research or "quest for knowledge for its own sake" can nevertheless often be not only a source of unexpected scientific advance, but can also ensure some degree of scientific and technological readiness within the country which may assist us in coping effectively with new developments. However, a balance must be established in the universities between this research on the one hand, which is usually based on established disciplines, and problem generated research on the other. One of the roles of government in funding research in the universities must be, in the overall interest of the country, to assist the universities in

maintaining a suitable balance of activity. It must be pointed out however, that the policy of government support to date in the universities has been based on the quality of the individual researcher regardless of the field of interest. This has led to a degree of imbalance in the Canadian scientific effort. Some fields of activity have been relatively oversubscribed as far as the national interest is concerned, while other areas have been neglected, and there has been little positive encouragement for people to enter these new or neglected fields of endeavour. We have clearly now reached the stage where a more critical appraisal of both the individual researcher and the significance of his work will be required.

It is also clear that the universities will now need to assume a larger share of the responsibility for the undertaking of research which is problem generated. (Internal reforms in the university structure will no doubt be required to facilitate this. The various methods of research support from governments can effect pressure for changes within the institutional structure of the universities and granting bodies must have an understanding of this). The initiation points of much university research are increasingly likely to be found in the problems of government, these problems being either largely related to social programmes or problems associated with economic growth or the generation of wealth in such a way that effective social programmes can be mounted and maintained. In these connections an increased degree of contact, understanding and cooperation between social scientists, engineers, scientists and the other professions is essential and attention must be paid to facilitating such interaction. Attention must be paid to the further development of the social sciences in Canada

and granting agencies be enabled to award funds for group project work. An ability to screen and advise on project research proposals must be developed.

As pointed out by the Science Council in Report No. 4, one of our failings has been in not ensuring that the results of research lead to innovation and that research projects are carried through to this final conclusion. Emphasis on the management sciences is called for and support is needed to induce engineers and scientists with some professional experience to return to university to undertake research and study in the management sciences particularly those directed towards the exploitation of research in science and technology, involving detailed attention to all parts of the innovative chain from research to marketing.

Attention is also drawn to the need for continuing post-experience education. This clearly has a role to play regarding our ability to accept and adapt to new ideas and techniques, and can play a significant part in facilitating the transfer of technology. Attention is also drawn to the need for industry and government to broaden their outlook with respect to the utilization of Ph.D.'s and some of the responsibilities of the universities in this regard are highlighted. It is also suggested that the universities could play a much more effective role in relation to Canada's responsibilities to the developing parts of the world.

In conclusion, it is suggested that the government could more effectively make use of the expertise in the universities not only without prejudice to the institutions themselves but indeed to their benefit. The recommendations included in this submission are made basically with this in mind.

II. RECOMMENDATIONS

1. That the universities be encouraged and given the support to assume more responsibility in the pursuit of research generated by problem recognition. This applied to the social sciences as well as to mathematics, science and engineering.

In order to accomplish this it is suggested that:

- (a) All government mission-oriented agencies be provided with substantial funds earmarked for the support in the universities of research which is generated by problem recognition.
 - (b) In supporting research in the universities, government agencies should consider research proposals in terms of relevance and effectiveness as well as in terms of the calibre of the research worker.
 - (c) Means be found of ensuring effective collaboration between government laboratories, the universities and industry.
2. That, in devising funding mechanisms for research support, government agencies act to encourage inter-institutional cooperation and coordination of activity. For example, the forming of ad hoc task-forces of people from various institutions to undertake specific studies related to problems of government should be encouraged. The allocation of substantial block-grants to encourage an inter-disciplinary team approach to various problems should be considered.

3. That consideration be taken of the fact that present Federal government funds for support of research in the universities are merely grants-in-aid which require supplementation by the universities through the provision of space, equipment, faculty salaries and other services. Granting agencies should be enabled to provide for such indirect costs associated with the research activity.
4. That the agencies granting "untied monies" for university research should be charged with the responsibility of ensuring that there is no neglect of fields of science which are either not currently fashionable or which are not being supported by any mission-oriented agency. We must acknowledge the possible impact of unforeseeable scientific advances and must maintain a technological readiness to respond quickly and effectively to such developments.
5. That granting agencies recognize the need for support of study and research in the management sciences. In particular, adequate support must be found for encouraging graduate engineers and scientists to undertake post-experience study and research in this area.
6. That government initiate more studies on the relation between research and social benefit. The support of research by any government must make economic sense and yet insufficient knowledge is available at this time to assure this.
7. That a body be charged with making a speedy, but thorough appraisal of the state of the social sciences in the universities; after which positive action be taken to provide the resources required to accelerate the development of research activities based on the established disciplines on the one hand and problem generated

research on the other.

8. That a government agency be charged with initiating and participating in an investigation of the likely long-term requirements of industry for continuing post-experience education. Support for research relating to the development of instructional techniques and teaching technologies needed to satisfy these requirements must be made available.
9. That a government agency such as the Canadian International Development Agency (or Department of External Affairs) work with the universities in devising ways and means of more effectively assisting developing countries in the field of education. Inter-institutional arrangements should be more strongly encouraged and supported in order that pockets of expertise about different regions of the developing parts of the world can be built up in various universities in Canada.
10. That attempts be made to clarify and define the means of implementing national science policy. This must include some clarification of the means of integrating this science policy with overall national policy for socio-economic development. Such clarifications will assist the universities in assessing their own role.

UNIVERSITY OF WATERLOO

SUBMISSION TO THE "SPECIAL COMMITTEE ON SCIENCE POLICY"
OF THE SENATE OF CANADAROLE OF THE UNIVERSITY

It is perhaps most appropriate to begin this submission with an expression of opinion concerning aspects of the role of the university in present society insofar as these are pertinent to a discussion of science policy. At the risk of over-simplification, the mission of a university might be thought of as divided into three parts viz., teaching, research and service. Much has been written regarding the inter-dependence of teaching and research in the universities, but there has been little discussion centering on the service role of the universities or the positive contribution this service can make to the teaching and basic research functions of these institutions. The universities will face a continual need to adapt to changing situations in this complex world. The demands upon the universities to provide advice and knowledge, related to the complex problems to which society will need to address itself, will undoubtedly increase. In modern society, as suggested by J. A. Perkins in his well known book "The University in Transition" (1), "there is almost no problem in our society that does not increasingly require expert advice. It is also true that expert advice can be found most frequently and in greater variety in the university than in any other institution". Our society is increasingly acknowledging the existence of the expertise concentrated in our universities and perhaps more importantly, is increasingly aware of the possibility of making use of this expertise on an individual or task force basis to undertake studies of various kinds, often in

conjunction with experts from other sectors of society, and so on.

Perkins (1) goes on to suggest two criteria which universities might use in attempting to place this service function in perspective:

(a) "the unique contribution of the university is knowledge, not operating skills, and this should be a limiting factor of great importance. The government and particularly the corporation have been organized in our society to get things done, and it is to these institutions that society normally looks for operational responsibility. The university's social scientists can provide the economic case for a sales tax, for example, but they should not be expected to collect the money. The fact that lines can be drawn between advice on how to do something and assistance in doing it thus constitutes a limiting force which aids the university in its need to preserve its balance and its unity", and (b) "the real integrity of the university is violated when large decisions in one area (teaching, research or service) do not consider the impact on the other two, in fact university integrity is compromised when decisions about any one of the three aspects of university activity fails to strengthen the others". However one interprets Perkins' opinions with respect to particular circumstances which arise in universities in Canada, it is clear that the universities, and by this I mean all the members of these institutions, must perceive quite clearly the various functions they are performing and exercise good judgement in maintaining an appropriate balance of activity within the various institutions. The discussion of the problem of coping with this dilemma is very pertinent to any discussion of the role the university might play with respect to national science policy. The problem really hinges on the difference between the traditional

discipline orientation of the universities as distinct from the mission-oriented society which supports them. Much of the difference is however one of time scale and to sacrifice the long-term needs of fundamental research in the universities to the more immediate perceived needs of society in effect kills the goose which lays the golden egg.

The universities must ensure that they play their traditional role of advancing the disciplines, while at the same time seeing that advances in knowledge are communicated in such a way that they can be readily utilized. Before discussing action that might be taken to achieve these ends, it would perhaps be useful to indicate the context in which technology and science policy are being viewed in this submission.

SCIENCE POLICY AND THE UNIVERSITY - SOME GENERAL COMMENTS AND CLARIFICATIONS

It has become very common probably as a result of patterns of discussion of OECD on the matter, to consider science policy in terms of "policy for science" and "science in policy", the one being related to the actions of governments regarding the organization and promotion of the nation's scientific and technological effort, the latter concerning the steps taken to ensure the most effective use of science in relation to the social, economic and political needs of the country. All facets of the university could thus clearly have some contribution to the development and execution of policy related to science and technology and this springs mainly from the fact that science policy is only a part of any overall government policy related to the attainment of our national goals or the sort of society which we would like to build, and which we feel is within our capacity. Being only a part, albeit a very important, perhaps increasingly important, part of governmental considerations, science policy

is not merely a matter for scientists. In the allocation of resources to science (science being regarded as embracing the knowledge of natural phenomena as well as the practical application of this knowledge) on a national scale, the considerations of governments must of necessity be made bearing in mind the broad social and political priorities rather than merely the needs of science itself. However, in these considerations, we are far from the position of being able to define our goals in detail, devise explicit alternative strategies for achieving these goals, undertake cost-benefit analyses of these various strategies and follow this by acting along the lines of the optimally selected strategy. We are still too ignorant of the many factors involved to be able to do this effectively, the relationship between, for example, research and social benefit being as yet poorly understood. The whole breadth of consideration of science policy can be further illuminated if we consider the changing nature of technology viewed in its broadest context. (The principles of scientific management when embodied in an organization are just as much technology as an automobile.) Similarly, as pointed out by Harvey Brooks of Harvard (2), "to the extent that social science knowledge is embodied in techniques such as market surveys, public opinion polls, educational tests, programming for teaching machines, or when planning procedures, it is technology. In short technology consists of codified and reproducible ways of doing things derived from rational principles". The "software" aspects of technology appear to be assuming an ever increasing relative significance and this in addition to the human element is good reason for including discussion of the social sciences in our consideration.

In summary, it is clear that science policy must touch on almost every aspect of our society and requires an increasing knowledge and understanding of this changing and increasingly integrated society. Consideration of the cost and benefits of technological change, consideration of priorities within science, between science and other social demands involves almost the total span of man's knowledge. The humanists and social scientists have their part to play alongside those of the scientist and engineer in ensuring that governments, in exercising judgements on behalf of society have available the maximum pertinent knowledge and information and the most expert advice. It is becoming evident that universities will increasingly be expected to accept greater responsibilities in this regard in addition to their traditional role of teaching and basic research. Universities will be increasingly involved in helping society respond to perceived problems, and indeed also in helping society at large perceive emerging problems. In short as suggested by Kash (3) "the demand is that universities take on a larger share of responsibility for applying the results of basic research to practical needs". This evolution of the role of the university is currently putting demands on the present institutional structures, which are, by tradition, discipline oriented and not in themselves able to cope with this changing situation. Such challenges, however, have arisen before in the historical development of universities and have been overcome.

THE EVOLUTION OF UNIVERSITY INSTITUTIONAL STRUCTURES

Introduction

A. M. Weinberg (4) has suggested that the mission of society is to

solve its variety of problems, virtually none of which can be resolved by the application of a single discipline. The universities on the other hand rather than being "mission-oriented" are traditionally "discipline-oriented". In addition to this, the rapid increase in knowledge is tending to lead to an ever increasing degree of fragmentation and specialization which in turn is leading to ever increasing difficulties and random delays in communication. At the present time the demand that universities become increasingly involved in the problems of society is acting as a counter-balance to these forces which tend to decrease the connections between university and society. The professional schools such as engineering have, of course, a very important part to play in bringing the knowledge of the universities to the service of society. In its brief to the Macdonald Committee (5) investigating the support of research in the universities, the Faculty of Engineering at the University of Waterloo stated: "we feel that the inter-disciplinary nature of engineering and the fact that engineers are becoming increasingly involved in the planning, development and management of our technological environment should mean that our engineering schools will inevitably take a lead in integrating efforts between society and the universities and enhance university-society interaction on a continuing basis. Engineering schools can in fact become a major bridge between mission-oriented society and the largely discipline oriented universities". It is true that Engineering Faculties have a tremendous opportunity in this regard. However, like all institutions of long standing such Faculties have also developed their own institutional rigidities.

The university must identify structures that will assist it in educating "middlemen" who can communicate the results of research to practitioners and who can communicate practical problems to researchers, whether they be members of Faculties of Arts, Engineering, Science, Social Science or Mathematics. In other words, we need people in the universities who can advance their disciplines and who can apply these disciplines or at least communicate the new knowledge generated in these disciplines in such a way that it can be used by people directly attempting to solve the various problems of society.

(b) The Social Sciences

The social sciences are perhaps in a unique position in our universities. Their varied locations within the institutions are largely the results of historical accidents. They are young disciplines with varied degrees of development and the existence of very distinct and differing schools of thought within and between the disciplines themselves lends great complexity to that inter-relationship. In addition to the inter-relations between the disciplines of social science there is a variety of inter-relations possible with other sciences. At the same time, the social sciences are dependent upon the culture in which they are being studied and thus share much common ground with the humanities.

The universities clearly have to develop flexible institutional structures that will enable the social sciences to progress and develop as disciplines and yet draw upon and contribute to the development of each other and to the professional fields such as engineering, and also the sciences and humanities. As in many other areas a solution has to be found to the apparent incompatibility between the development of the

disciplines and the inter-disciplinary nature of the real world problems that will face those educated in the social sciences.

Many universities are experimenting by forming various new academic groupings of Faculties of Social Science, Schools of Environmental Studies etc. Other universities are developing institutes that do not conflict with pre-existing departmental or Faculty structures, but exist to mobilize the resources of the university to undertake large scale studies connected with, for example, urban problems, resource management and so on the completion of which requires the contribution of engineers, social scientists and other members of the university community. Much effort is being expended within our universities in finding adequate ways to treat this problem in terms best suited to the various particular institutions. However, there appears to be a strong indication from the social scientists that the resources that our society has allocated to the social sciences has been and still is woefully inadequate in relation to the urgency for modern society to acquire scientific knowledge of itself in this time of change brought about by the advances of science and technology. Until adequate resources are made available to the social sciences, questions of institutional structures are perhaps of a secondary nature. In considerations of funding, governments must nevertheless be aware of the likely impact on the institutional structures of various patterns of research support.

(c) Engineering and the Sciences

Perhaps the sciences are least hampered by the problem of institutional structure, but even here it must be acknowledged that many

of the growth points in science are appearing in just the areas where traditional fields intersect. This could clearly lead to some neglect of these areas, but as far as our development is concerned at Waterloo the present fairly traditional structure of the Faculty of Science has been able to respond successfully in supporting such developments. The Science Faculty has three major departments viz. biology, with special emphasis on ecology, physics with special emphasis on solid state research and the application of solid state devices and chemistry, which has pioneered an applied chemistry programme with a view to the needs of Canadian industry.

The Engineering Faculty also appears to have solved any problems which might have arisen due to its institutional structure. The Faculty of Engineering at the University of Waterloo is currently the largest in the country and offers a wide range of activity and yet it achieves this basically within four main departments and two developing departments of Design and Management Sciences which have to date concentrated upon post graduate activity. A consideration of the activities within the various departments indicates very clearly the inter-disciplinary nature of engineering and the acceptance of this philosophy within the Faculty, which incidentally does not consist entirely of engineers. The activities range from highly theoretical analytical work in solid and fluid mechanics, through the application of knowledge in such fields to manufacturing processes and pollution in the Great Lakes etc. Work also ranges from the investigation of control of forest fires to transportation planning, from materials sciences to resource management and so on. The internal structure of the Faculty has provided no barrier to the development of such diverse activities. Similarly the

university structure does not appear to have inhibited contact and cooperation between scientists and engineers. However, the increasing involvement of engineers with social and economic factors related to the planning, development and management of our technological environment demands an increased degree of contact, understanding and cooperation between the social scientists, the engineers and of course other groups such as the architects, the medical and legal professions. It would appear that some communication barriers need to be overcome in this regard. The tendency of the engineer to quantify means that he is often talking a language not understood by those social scientists educated several years ago to an almost totally qualitative opinion type approach to their subject. This difficulty has perhaps also arisen within the fields of the social sciences themselves. Clearly, research in the social sciences can never be limited to the strictly quantifiable or even measurable. Nevertheless, the problem of communication remains, although the common language appearing through the growing acceptance of the systems approach to the solution of complex problems may provide a fertile meeting ground for the engineer, the social scientist, the architect and others, as well as providing a focus for the various points of view within the social sciences themselves.

(d) Other Groupings

Attention must be drawn also to the important role that groupings such as Administrative Studies, Management Sciences, Architecture etc. can play in the University scene. The Management Science Groups attempt, for example, use the techniques of operational research developed by the mathematician and apply these techniques

in conjunction with a knowledge of social sciences, engineering, etc. Schools of Management Sciences can play a vital part at the discipline/mission interface. The architectural schools clearly can perform a similar function, embracing as they do considerations, economic, social, aesthetic and technical.

(e) Inter-Institutional Arrangements

There would seem merit in consideration being given to the formation of inter-university institutes to enable task forces to be assembled to tackle certain problems or to make more effective the use of expensive equipment and other facilities and the avoidance of unnecessary duplication. These institutes would be people-centred rather than facility-oriented and would enable the researchers involved to get together, to assess present facilities, staff specialties etc. and exchange information regarding prospective equipment purchases, the hiring of new staff and so on. Involvement of government laboratories in such institutes would also seem to warrant serious consideration.

In conclusion, it is clear that universities must constantly be prepared to adapt their institutional structures if these are to be fully effective. These structures can be influenced by external forces as well as by internal considerations. Relationships and inter-action with government departments and industry, and methods of funding can all influence the pattern. Nevertheless, formal structure should be emphasized only insofar as it can help to create an environment conducive to good communication and cooperation. The prime factor is always the individual, his competence and willingness to work with others.

ALLOCATION OF FUNDS TO VARIOUS TYPES OF UNIVERSITY RESEARCH IN CANADA

In the sciences and engineering the main source of research monies has been the National Research Council. The universities themselves, mainly from the operating and capital grants obtained from the various provincial government have provided the bulk of the facilities necessary for research to be undertaken. Basically the objective of undertaking research in the universities is to provide a vehicle for the education of graduate students, to ensure that the competence of the faculty is maintained, and that the undergraduate programmes remain up-to-date and provide a live educational experience which will prepare the graduate to make an effective contribution to our society. The university is also concerned with the generation of new knowledge and is becoming increasingly concerned with the study of ways of using knowledge. It is in this latter area that the Engineering Faculty in particular indicates a deficiency in the present granting system. It is suggested that with a multiplicity of agencies, particularly the mission-oriented departments of government, committed to the support of university research, then the research conducted within the engineering schools would have achieved a more appropriate balance between basic research, applied research, involvement in design and involvement with industry in development studies. The Faculty of Engineering has argued that the National Research Council has been very effective in providing untied monies for the support of research. But for the system to have been really successful, this support should have been augmented with other funds for research arising from problems of special interest to Canadian industry and other government agencies. Unfortunately this has not been the case, and funds from other sources for oriented basic

or applied work have to date been small and short range, and industrial support has been almost non-existent. Industry has been very reluctant with possible rare exceptions to support any long-term basic activity. Perhaps one of the major causes of this somewhat unbalanced research pattern is the fact that the growth of secondary industry in Canada is relatively recent and comparatively slow. This has meant that up to now industrial management has been concerned almost exclusively with the many elementary and short-range needs and opportunities for engineering work, and an appreciation of the role of longer range considerations has consequently been slow to develop. Apart from this serious deficiency, the N.R.C. system for providing "untied" funds to the individual research worker where the researcher is subject to the principle of judgement by his peers with respect to his competence and creative output, seems to be generally well accepted particularly within the Faculties of Science. There have been however suggestions that better methods be established within the system of ensuring value for money and the prevention of waste on continuing sterile activity. However, consideration should be given to coordinating the provision of research funds with the availability of facilities, and with the administrative and technical support which the universities themselves can provide. Adequate consideration must be taken of the real cost of the work to the university. In fact, the whole question of suitable overheads on research grants should receive some study.

The role of development and contract work must not be overlooked. The characteristics of work covered in this category are well defined end-products or processes which must be produced within

a specified period. University engineering schools in particular must undertake a limited amount of work in this category in order to maintain an awareness of commercial realities and the pressing requirements of strongly mission-oriented federal agencies such as the Department of Industry etc. Propriety rights of the sponsor must be respected and the work must be fully funded with respect to overhead costs. It is clear that much of such contract work would not provide thesis work for a graduate student but it must be an integral part of the activity of an Engineering Faculty and can be used as a means of part-time or "summer employment" for graduate students or employment over a longer period for those with industrial experience and family responsibilities, who need to spend periods up to a year in financially gainful employment in order to finance their graduate studies. It is expected that private industry, particularly smaller companies who are not able to employ a permanent staff for research and development work, will begin to look more towards the universities for technical expertise on a task force basis. The decision of the Department of Industry to establish Industrial Research Institutes associated with various universities is directed at this problem. It is felt too, that the formation of the Canadian Organization for Joint Research may also enable the universities to become more aware of the needs of industry and government agencies, and at the same time enable the universities to become more aware of the needs of industry and government agencies while acquainting industry and government to be aware of the expertise, interests and facilities available in the universities.

The very limited support for work in the social sciences in Canada clearly needs serious investigation. At the present time it certainly fares badly in comparison with science and engineering. This is no doubt partly due to the stage of development of some of these relatively young disciplines particularly on the Canadian university scene. (Comparison between the support of engineering and science in the universities a decade or so ago would yield a similar pattern. Research in engineering was very slow to develop in Canada but the development over the past ten years has been startling). Present funding would appear insufficient to develop the various disciplines and to develop means of application of the studies in the social sciences. University faculty in these areas draw attention to the short-term nature of the research grants, usually limited to one year, the general inadequacy and the problem of uncertainty regarding any long-term continuity. The lack of support for graduate students in the social sciences appears to be a major factor retarding the development of quality in the social sciences in the universities. The social scientists at the University of Waterloo have suggested that consideration be given to the provision of the following kinds of research support: -

- (i) Grants to individuals with prospects of renewal.
- (ii) Block grants to interdisciplinary groups for specific major research projects running over a several year period.
- (iii) Block grants to Research Institutes or other Faculty organizations for non-specific pure research. These grants would make it possible to support investigations that are often too preliminary to make them worthy of

support by project-oriented agencies. These grants could be considered as "seed money".

- (iv) Research fellowships for graduate students.
- (v) Overhead grants to the institutions of the research grantees.
- (vi) Grants for Computer Equipment and Data Banks.

The application of quantitative methods and computer techniques to research in the social sciences is often handicapped by the lack of suitable "software" and data banks.

The Science Council and the Canadian Council through the committee chaired by Dr. J. B. Macdonald have been giving this whole question of support for university research serious study and perhaps further discussion of the support question is not warranted at this stage in this particular submission. However, we have indicated what we feel to be some of the major areas requiring consideration. It would appear that a study of the state of the social sciences in the Canadian universities would be in order. It is suggested that the impact and methods of approach of such organizations as the National Institute of Health in the United States regarding the support of work in the social sciences be studied. This is particularly important in regard to the question of the provision of funding for group projects on an area basis and for the development in the funding agencies of the ability to screen research proposals in terms of the project, the group of individuals concerned and the institutional facilities available. Since

the Science Council has already completed a study on psychology, it would perhaps be appropriate that the Science Council, and say the Canada Council initiate such a study of the social sciences. Attention must be drawn particularly to the research taking place at the what might be regarded as the interface or intersection between the traditional disciplines, whether it be between science and the social sciences, between the sciences and so on. These areas can be exciting growth points and in the development of funding systems particular attention must be paid to these possibilities in order that opportunities are not missed because of somewhat arbitrary or traditional administratively convenient divisions of responsibility in the field of university research support.

PRIORITIES FOR RESEARCH, RESEARCH MANAGEMENT AND COORDINATION WITHIN
UNIVERSITIES

The question of priorities is of course a difficult one. Governments must develop an overall science policy which can identify priorities. However, as stated in the Carter Report on Taxation, Volume 2, "so little is known about the kinds of research that are required, and who should do it, that it is dangerous to take a firm stand. Canada desperately needs some research on research." It is essential that we establish a study of the measures of social benefits arising from research and developments in science and technology. These measures or benefit functions can then receive public discussion in order that more realistic political decisions can be made regarding priorities

and scales of support etc. than is possible by a centralized choice between areas, specialized committees and vocal pressure groups. In the absence of the results of research on research it is essential that the decisions about research which are made by government be made on the soundest advice available. The various members of the university community clearly have a role to play in this regard.

The individual universities will also have to pay attention to the development of priorities, probably involving some rationalization not only on a Provincial basis but also on a Federal level. This may well raise the question of some combined Federal/Provincial body or forum in which these matters can be discussed. The Universities will certainly be required to identify their areas of strength, develop viable research groups, encourage interaction and cooperation between individuals and groups both within the university and outside, choose between possible competing demands on the available resources, particularly space. All this will require a degree of management which is somewhat new to the universities, and problems arising concerning the relationship between Directors of research divisions, groups or institutes and Department Chairmen and Deans will require solution on individual campuses. As mentioned earlier this constitutes a part of the challenge to present university structures and the universities are all presently in various stages of adapting their various structures and methods of operation. It is important that this process be understood by those outside the university who are concerned with influencing or working with the universities in various ways.

INTERACTION BETWEEN UNIVERSITIES AND GOVERNMENT RESEARCH ESTABLISHMENTS

Ways must be found of ensuring that effective relationships exist between universities and government laboratories such that competent research personnel from the universities and private industry can have some influence on the research activities carried out in government laboratories. The Sutherland Report (6) in its report on this question on the United Kingdom scene identified five principal ways in which universities and government research establishments might be brought into closer relationship to their mutual benefit and to the national advantage:

- (a) Closer staff relationships
- (b) Cooperative research projects
- (c) Formal association of research establishments with universities.
- (d) Recognition of establishment research for higher degrees.
- (e) Easier mobility and transfer.

This question is clearly one which merits study within Canada and the whole range of possibilities should be fully explored. The Faculty of Engineering suggested one possible approach to the problem, recommending that:

- (a) each government research laboratory or research agency have an advisory committee on research. The membership of this committee is to be composed of active and competent university and industrial researchers capable of assessing the work of the particular laboratory and making recommendations regarding its research activity and that,

- (i) these committees are to meet several times per year at the laboratory and have an intimate knowledge of its activity.
- (ii) These committees are to submit to the Deputy Minister, responsible for the government department operating the laboratory, a short annual report on the activity containing recommendations for future work.
- (iii) these committees are to be charged with investigating means of more effective collaboration with the universities and with private industry.

CONTINUING EDUCATION - THE COMBATING OF OBSOLESCENCE

It is becoming apparent that the demands upon the universities will increase in the field of continuing education. It is difficult to forecast the rate of acceleration of this demand, but it will undoubtedly become a significant factor in university development sometime in the future. The American Society of Engineering Education (7) advises for instance that "the profession and academic institutions which serve it, must look forward to a growing activity in continuing engineering studies as a distinct educational function, outside of advanced degree programmes. This is not merely a matter of dealing with current obsolescence, retreading, retraining, or any of the other popularized versions which have been developed, sometimes almost frantically, to satisfy urgent localized needs. It is rather a matter of establishing and maintaining an entirely new dimension of personal development throughout the engineer's career". Similarly, in the United Kingdom the

recent report on the "Flow into Employment of Scientists, Engineers and Technologists" recommends that "more attention should be given to education and training throughout the career and after experience of employment". This report goes further in recommending "that industry should be intimately involved in the planning and conduct of post-graduate education and training which is intended to meet its requirements." In Canada, we cannot afford to ignore these suggestions. There are also many social implications arising from the problems of obsolescence of educational qualifications. When new graduates from the universities are not able to communicate with their supervisors, then their potential effectiveness is reduced and the traditional authority and prestige of the supervisors and indeed senior management itself is undermined. (In a similar manner many of our problems regarding the "generation gap" could perhaps be traced to the rapid rate of change in our traditional values and authority patterns).

The universities will need to react to these situations. It seems probable that the recent increase in the availability of the short residential "appreciation" courses, "state of the art" courses and so on are merely the first manifestation of this. This will provide an increasing challenge to the universities with respect to instructional techniques especially with regard to meeting the needs of those unable to attend the institutions for such courses. One can foresee the universities and other institutions of post secondary education becoming increasingly involved in application and research into various aspects of "teaching technology". This latter work will of course require a clear source of financial support.

It is suggested that a study be undertaken regarding the need for continuing education which can satisfy needs to upgrade, update

or diversify a person's education or enable him to add new perspectives to his own field; for example, the practising engineer may wish to gain more knowledge relating to economic, political and social matters which may have some bearing on his professional activity. The Department of Industry, Trade and Commerce or the Department of Manpower are perhaps the agencies of the Federal Government which could initiate and support a study into the requirements of Canadian industry in this matter.

GOVERNMENT AND THE INTERNATIONAL ROLE OF CANADIAN UNIVERSITIES

As pointed out by P.H. Coombs (8) the rampaging forces of change throughout the world have given rise to an educational crisis born of the historic conjunction of five factors viz. (a) the student flood, (b) acute resource scarcities, (c) rising costs, (d) unsuitability of output, (e) inertia and inefficiency. The crisis certainly differs in timing and intensity from place to place. While, of course, we do have serious problems in this regard in Canada, it is in the poorer countries of the world where the crisis is most severe. It is very important that we recognize that a challenge presents itself with regard to the developing countries and that we agree that the universities can play a very active role in meeting this challenge. For example, the universities can "help establish and spur the growth of new higher educational institutions in developing countries, along lines which suit their needs and circumstances and are not simply carbon copies of the assisting universities". There is probably a need for more concerted effort on an institutional basis - the sending of instructors on an ad hoc basis from any university to fill teaching slots is definitely not the most

effective approach. The need is for individual faculties or universities to have long-term relationships with individual institutions in developing countries in order that the real problem can be fully understood and a degree of expertise and knowledge be built up in the Canadian institution. Included in such arrangements would of course be a two-way flow of personnel on a term-basis. It is acknowledged that a certain amount of inter-institutional contact is in evidence now (including inter-institutional arrangements between ourselves and universities in the industrialized countries). However, it seems evident from within the universities that representatives of the individual universities should cooperate with government in making a study of ways in which the various institutions can play a more effective part with regard to the nation's responsibilities on the international scene.

GENERAL CONSIDERATIONS

It is probably appropriate to comment on the manpower output of the universities at the Ph.D. level in view of statements which have been made by representatives of some industrial, government and university institutions. It would appear, at least in aggregate, that our universities are capable of educating at least the number of Ph.D.'s which the country can usefully absorb given the current pattern of utilization. It would seem that we need at this time to consider the creation of an environment in which the skills of these graduates will be effectively utilized. To obtain a return on the current and continuing investment in the education of Ph.D.'s in engineering and science we must either increase our research effort in this country (particularly mission-oriented research and its subsequent application)

or explore other areas in government and industry in which these Ph.D.'s can be usefully employed. This will demand increased flexibility from the Ph.D. graduate too and could also be an inducement to the universities to experiment with various approaches relating to the awarding of higher degrees. For example, the Swann Report (9) recommends on the U.K. scene that "universities should examine the nature and purpose of the Ph.D. degree from first principles, and consider drastic action to bring within its scope other forms of post graduate training more closely oriented to the requirements of industry. The aims of the Ph.D. and the implications of possible changes for science and technology and for qualified manpower need to be considered. The time is long overdue for the universities to start experimenting boldly with the Ph.D. and with the regulations which govern the award of this degree". We would be remiss if we did not take note of this recommendation as far as our own universities are concerned. Industry, universities and government will all be required to play their part in ensuring that the output of the universities is appropriate and is used effectively. There is a school of thought of course which regards investment in education as a primary motive force in an economy. J. Herbert Holloman, a former Assistant Secretary of Commerce for Science and Technology in the United States expressed this opinion as follows: "Probably the most significant principle of technological innovation is that it is determined by the educational system. The pressure arising from an investment in education produces more highly skilled people, which, in turn, requires a different productive process, which, in turn, requires capital investment, which, in turn leads to improvement in productivity". To what extent this opinion is valid is difficult to say. It is clearly

a complex relationship and the question of time scales etc. relating to this are probably not well understood and will require further study.

In conclusion, it is becoming increasingly evident that one of the problems of our society lies in ensuring that our policy making machinery remains up-to-date. The rate of advance of technological knowledge is providing our decision making institutions with an enormous challenge. We will likely need to much more consciously make choices regarding social direction rather than merely attempt to adapt our society to new knowledge as we have done in the past. Science and technology while creating problems are also providing many of the means of solving them. Professor Y. Dror of the Hebrew University of Jerusalem has highlighted this in a recent book (10) in which he pleads for the acceptance by universities of "policy science" as a distinct field of study. Policy science being a discipline directed at a study of the means of improving the design and operations of policy making systems and how to increase the role of policy making knowledge in the operation and improvement of the policy making system. For example, what changes in our policy making system are necessary if we are to use the modern knowledge of the decision or management sciences or say, the new knowledge about the conditions that encourage creativity which is emerging from psychology and organization theory? As Dror points out "to assimilate new knowledge into policy making machinery quickly and skillfully, the situation must be analyzed, the changes in it that are both feasible and needed must be pointed out, and steps must be taken to ensure that when changes become possible or needed, they will be made". He goes on to suggest that "it is up to the academicians, who are one of the few

social strata having the necessary time and detachment, to undertake the first part of this task, analyzing the present and as far as possible, the future, and pointing out the main directions in which change and innovation are likely to be needed".

The development of a national science policy, which of course must be a dynamic continuing activity, and the integration of this policy into national policy for socio-economic development will require a very critical review not only of our present capabilities in science and technology but will also require a continual review of our total policy making machinery, including the ways and means of executing and evaluating the various policies devised. Attention must be paid to the long range view and it is here that academics may be able to make the most valuable contribution. However, involvement in more short-term problems is also necessary if these academics are to remain in touch with reality and the "art of the possible". Society must tap the resources of knowledge which are available in the universities and this must be done in such a way as to avoid detrimental long-term effects on the development of the various disciplines. The Science Council has made a start in Canada by introducing a framework for the discussion of science policy and what is now needed is some indication from government of the ways and means being considered regarding the implementation of science policy. Public discussion of this matter will assist the universities in clarifying their own role.

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APPENDIX 73

Brief submitted to the
Senate Special Committee on Science Policy
by
The University of Toronto

1. Goals for the Federal Government in support of research

First we would define research as a diligent seeking after new knowledge or the rediscovery of old - the systematization and co-ordination of a complicated pattern which will help us to understand the past and present and to predict the future. With this interpretation we would describe the goals of the Federal Government as follows:

- a) to enhance the cultural and scientific achievements of Canada on which the quality of our national life, our external prestige and internal prosperity depend;
- b) to investigate and determine the conditions under which our natural resources and economic potential could be developed in the national interest;
- c) to ensure the development of a strong and flexible research training capacity in the country.

These aims cannot be completely separated since the prestige of Canada abroad is a pertinent factor in attracting talented people, who in turn contribute to our development. But scientific achievement is directly related to the growth of our technology and so to our prosperity.

We would express our strong feeling that the Federal Government has the main responsibility for the support of research in the country. To relinquish this responsibility to the Provinces, we feel would be disastrous. (Recommendation I)

2. The universities' objectives in conducting research

Research cannot be separated from inspired teaching, undergraduate or graduate. We make a distinction between technical or junior colleges as they have developed in Canada and our universities. We feel that research should go on in all universities whether they have a graduate programme or not. Indeed it could be taken as the characteristic of the university professor that he should be continually striving after new knowledge. Such independent activity is necessary if students are to continue to benefit. This is equally true in all areas of scholarship, not only in the natural and physical sciences, but also in the humanities and social sciences.

The Federal Government has recognized the need by greatly increasing the grant to the Canada Council in recent years. This will go a long way to correct former inadequacies of support which have been keenly felt in this university.

Training students for research is clearly the responsibility of the university and in many instances it can lead to a graduate degree. However, the University does conduct many other types of training in many areas from social work to public health and this is part of our contribution to the life of the community. The responsibility is often shared between the Federal and Provincial Government and this is as it should be.

Research in engineering, medical sciences and social sciences will often be directed to the accomplishment of specific goals. These goals should be chosen by the individuals or groups of individuals concerned and they should usually involve graduate students. The National Research Council has done much to stimulate contacts between faculties of engineering and industry but much remains to be done. We must stimulate research and development in industrial laboratories not only in government laboratories.* (Recommendation II)

3. Implications

What we have said so far implies a wish on the part of both government and universities to work together for the common good. With this assumption, what are the implications on both sides? Let us look at the relationship first of all from the point of view of the universities.

- a) As we have indicated, external support must conform to the needs and pressures of the academic world. At the University of Toronto we have tried to formulate conditions under which research could be sponsored by an outside body in our pamphlet, a copy of which is attached; the chief points have to do with
- (i) the involvement of students,
 - (ii) the interest of the University in inventions made by members of the staff, and
 - (iii) research involving the testing of human subjects.

Systematic procedures have been worked out with reference to (ii) and (iii) but not all government departments appreciate the need for the University to insist on the publishability of the results of research where students are involved. The university of Toronto belongs to an increasingly large company of universities which feel that classified research should be done in government or industrial laboratories. More generally, that the grantor should not have the right to prevent or greatly delay publication of university research. We attach also a copy of the University of Toronto publication policy.

- b) From the point of view of the Government the public good is best served by involving academics in a meaningful way in the evaluation of applications and in the distribution of funds. This has been done to everybody's satisfaction by the Medical Research Council and the National Research Council and it has led to an improved understanding of the need for responsible use of public funds as well as the need for co-operation amongst Canadian universities. Recently Canada Council has taken some useful steps in this direction.

* These first two paragraphs of the report were substantially contained in the brief from the University to the MacDonald Committee. What follows emphasizes problems which have arisen in the last two years which we see as important to bring before the Senate.

We pass on some specific comments and recommendations on the kinds of grants required. (Recommendations III to V)

The distinction between a grant or a contract has become blurred in the United States. Budgets are required in each case and since the project is usually initiated in the university a formal agreement in contract form has significance largely in cases where some patent or commercial interest is involved. So long as (i), (ii) and (iii) above are satisfactorily covered, the University of Toronto has no great preference for the one form as opposed to the other. We would, however, emphasize the danger of university staff members prostituting themselves and their institution by undertaking research projects of a routine character which have little to offer to the training of graduate students.

c) Overhead

A major problem for the university is to relate Federal and Provincial Government support, since the operating budget of our University comes from the province. We shy away from the practice so wide-spread in the United States of allocating a professor's time between teaching and research. The difficulties here are frustrating for all concerned and we believe that all academic salaries should be paid by the University. In an extreme case, where the needs of the research project are inconsistent with this principle, a part time appointment is preferable or even leave of absence. It follows from this that the Province will share in any research project.

The study of the indirect costs of research has been covered in a brief written on behalf of the AUCC for the Science Council. We quote its recommendation as our recommendation VI. Uses to which such funds will be put thus become a matter of internal decision. The Board of Governors of the University has declared that such overhead shall not be used to stimulate new research thus adding further indirect costs. We have worked out a basis whereby the Department in which the research goes on may benefit through the use of such funds for specified costs ancillary to research projects. A portion of such overhead should go directly to the University.

4. Relations between granting bodies

- a) We come now to the crucial part of this brief and ask the question how are government funds for the support of research to be distributed to government departments, councils and agencies?

Could the Science Council exercise any real supervision over Government research policy with reference to the question raised above? The alternative is some super committee to advise Treasury Board not only with regard to the budgets but also on projects of "big science". This subject has been considered at length by the MacDonald Committee and more on it may be found in the O.E.C.D. draft of their Report on Science in Canada. It does not seem useful at this point to attempt to obtain a consensus in the University of Toronto but we would stress the importance of recommendation VII

The problem is twofold in several large government departments (e.g. EMR, Agriculture and National Health and Welfare):

- (i) to properly relate "in house" research to University and industrial research and,
- (ii) to involve academics in a meaningful way in the distribution of grants and contracts.

We would cite the approach adopted by the National Research Council with regard to both (i) and (ii) as worthy of emulation.

The problems of "big science" must be taken seriously and the academic community involved at every stage. The development of major scientific projects of the "Brookhaven" pattern is a trend which can hardly be resisted. Such involvement could have avoided much of the frustration and dissatisfaction which has followed the cancellation of ING and the QE Telescope. (Recommendation VIII).

- b) In Canada there is a continually increasing demand by Government and industry for quantitative studies to which the Universities should be able to contribute. We have been late in coming to this problem, but the following table taken from the report of the U.S. President's Science Advisory Committee which appeared in February 1967 is significant. This table records substantial needs for computer time in major areas of study in American Universities based on Bachelors programs for the years 1963-64.

| | |
|--------------------------|-----|
| 1. Social Sciences | 24% |
| 2. Engineering | 21% |
| 3. Biology | 15% |
| 4. Business and Commerce | 14% |
| 5. Physical Sciences | 11% |
| 6. Mathematics | 6% |
| All other | 9% |

It should be noted that these figures do not refer to research use but to undergraduate programmes. Nevertheless they are extremely significant in that the social sciences, including business and commerce, could soon account for 40% of the total. Since nearly all university computer facilities in Canada have been provided by the National Research Council, it is clear that some drastic action must be taken in the immediate future if the growing disciplines' needs are to be met.

In Ontario, the Provincial Government has begun to support digital computers on a large scale and this places the allocation of time in the hands of the universities. If one accepts the need for greatly increased instruction at the undergraduate level then Federal granting agencies must take their share of responsibility for research and they must do so in a consistent fashion. For example, if a given project involves computing then that should also be taken into account in making the grant or contract. The Defence Research Board has recently resumed support of computing involved in a given project but other Government departments show no inclination to do likewise. Unless all Government granting bodies recognize their responsibility in this area we are heading for trouble. (Recommendation IX)

RECOMMENDATIONS

- I The Federal Government must maintain its role as primary sponsor of research in the universities if we are to continue to play a significant role in the international scene.
- II Assistance and encouragement should be given to industry to develop research in industrial laboratories.
- III Strong support is given to the extension of a term of a grant from one year to three years in all areas. It has been suggested that the step funding of grants now in operation in the United States should be adopted for Canadian agencies.
- IV There is a wide support in this university for an arrangement which would bring the grant year into coincidence with the university year and would make decisions known in the autumn rather than in March or April, so that suitable appointments of staff and students could be planned in advance.
- V Current Federal fellowship programmes should be expanded so that the support of graduate students would be less dependent on research grants made to their mentors.
- VI Every government grant or contract for research should carry a supplement of at least 30% to cover a portion of the indirect costs. Such supplement should be paid to the University with no strings attached.
- VII The distribution of government funds for support of research and also the way in which the funds are utilized by government departments, agencies and councils should be the subject of advice and criticism by a duly constituted government body.
- VIII Major scientific projects should be placed in proximity to Universities interested in their use. Such projects should be organized on the Brookhaven pattern or, if Government controlled, arrangements should be made to co-ordinate Government and University research projects through a council on which academics are adequately represented.
- IX All Government departments and granting agencies must face the problem of the support of computer facilities in universities which arises from the increasing use of computers in the Humanities and Social Sciences.

UNIVERSITY OF TORONTO PUBLICATION POLICY

Since the dissemination of knowledge is one of the primary functions of the University, University research should be such that the results may be freely published. The policy of the University of Toronto with respect to publication is as follows:

Results of research undertaken in the University shall be fully publishable with the following qualifications:

- (a) In cases where a Sponsor may have industrial or commercial rights arising out of a research project, the University will be prepared to accept restriction of publication for a period not to exceed 90 days after submission to the Sponsor of the proposed text.
- (b) Where the Sponsor wishes to be given an opportunity to publish the results of the research before publication by the University, such right may be given provided that;
 - 1. the University shall, in any event be free to publish after 12 months from the submission of the final report to the Sponsor,
 - 2. if there is any change in the Sponsor's publication from the original report, the name of the University shall not be used in connection with the publication without the written consent of the University, and
 - 3. publication of a thesis by a graduate student shall not be delayed by such restriction.
- (c) Where by the terms of a contract or grant, the Sponsor agrees to provide data essential to the research, which, at the time it is provided, is labelled "Confidential Data", and where the Chairman of the Department in which the research is being conducted considers the research of such importance to the Department that the general rules with respect to publication should be partially waived, the University will be prepared to accept such grant or contract and observe such confidentiality provided that the results of the research may be published without identifiable reference to the confidential data.

27th January, 1969.

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APPENDIX 74

Brief submitted to
The Senate Special Committee
on Science Policy
by
Saint Paul University, Ottawa

1. Saint Paul University is pleased with the study undertaken by the Senate on the science policy of the federal government. It is particularly pleased with the universal scope of the study which embraces the human sciences.

2. Within the context of Ontario universities, Saint Paul University forms a university federation with the University of Ottawa. Through a mutual agreement within this federation, Saint Paul University has agreed to limit itself to the development of research and teaching in the human sciences, particularly those with religious and ethical implications. These are the sciences relating to the discovery and study of the meaning and value of human life.

3. Considering these sciences as an essential dimension of the society in which we live and aware that they are included in the order of reference of the Senate committee, Saint Paul University wishes to draw attention to these matters so that the complete brief to be prepared at the end of phase III may take this body of sciences into account. These sciences are quite frequently neglected in discussions on scientific research and, as a result, do not fare particularly well in budgets for research assistance.

4. The present brief will include two parts:

- I. Human sciences with religious and ethical implications.
- II. Suggested means for supporting research into the sciences.

I. HUMAN SCIENCES WITH RELIGIOUS AND ETHICAL IMPLICATIONS

Not wishing to draw up an exhaustive list on the subject, we feel that the following enumeration and descriptions should give an approximate idea of the extent and importance of these particular fields of research, several of which are inter-disciplinary in nature.

1. Religious Sociology

For a number of years, sociology has shown interest in the religious problems of society. The method of investigation particularly favourable to the work of this science has already made it possible to evaluate numerous ills, direct solutions and support research into all areas of social life.

2. Religious Psychology

Psychology has long been concerned with the religious dimension of man. The discoveries of contemporary psychology have

created still closer ties between psychology and religion. In particular, the psychology of the mind (psychiatry or psycho-analysis) is opening out new paths for research and therapeutic methods.

3. Religious History of Canada

No one can deny the religious origins of Canada and the religious influences which have acted on its development. Institutions, colonization, political movements, education have all been influenced by religion. The study of this history has scarcely begun. Here is a vast field which must be explored if we are to know our country. A number of archives contain an abundance of material which needs only to be investigated.

4. Canadian Anthropology

In Canada, a number of studies, enquiries and research have been conducted into the field of Amerindian anthropology. This is a beginning.

In the study of anthropology, the whole area of community development and urban renewal must be considered. Study and investigation into these aspects are necessary if we are to plan and direct our urban centres of tomorrow.

In both cases, problems of "values" are involved which cannot be left entirely in the hands of economists and architects.

5. Family Sciences

Western society considers the family unit as the basis for its survival. A number of scientific disciplines are concentrating more and more on the study of the values of the family. Such studies meet a real and pressing need if we are to cope with our constantly changing world; the technical revolution, the urbanization of vital centres, the rapid means of communication place the family in new situations which often cause considerable confusion. The family sciences are concerned with these problems and work in their own way towards safeguarding the values we continue to hold as fundamental.

6. Religious Law

This branch of research is very closely related to the study of common law. We cannot delve into the history of our country without undertaking serious studies of religious law as this law has presided over initiatives and efforts which, since the origins of our country, have helped to make us what we are today.

7. Mass Media (Social Communications)

The profound impact of modern methods of communication on the new mentality which is taking shape demands careful study and serious research. The whole problem of values is so intimately

bound up in the development of the mass media that interdisciplinary research into this field deserves special attention.

8. Ecumenical Movement

In an age when ways of uniting mankind are of interest to all those working towards the advancement of society, the problem of the division of man on the religious plane should concern any thinking person. The disciplines concerned with the grave questions of ecumenicalism are now in the developing stages. This area will require many more religious thinkers in the years to come. The disappearance of a great many religious prejudices at the source of secular divisions will depend on research and study into this sector.

II. SUGGESTED METHODS FOR SUPPORTING RESEARCH IN THE SCIENCES

We suggest below possible ways to assist research in the sciences we have just described.

1. Libraries

Libraries are the first tools for the advancement of research in the human sciences. However, libraries orientated towards the religious and ethical sciences have difficulty in obtaining the assistance they need to develop adequately. The library of Saint Paul University is recognized throughout Canada and the United States. The report of Mr. Edwin E. Williams on "Resources of Canadian University Libraries for Research in the Humanities and Social Sciences" (1962) has this to say about the Saint Paul University library:

It seemed desirable... to give some attention to materials on the history of religion that are available in university libraries to supplement their collections in closely related fields. The sampling of periodicals in this subject indicated that Ottawa is in the lead with greater strength than the University of Toronto alone...

(p.27)

Ottawa has nationally outstanding collections for philosophy and religious history, with advanced research holdings for work in...mediaeval studies.

(p.50)

Indeed, a great number of researchers gather here for advanced study and research. Nevertheless, for one reason or another, those responsible for distributing grants to the research libraries did not feel it necessary, last year, to grant this library the very small help it requested. We feel this is a grave omission; assistance to research should cover the specialized area which we represent.

2. Research, Investigation

Most of the time, research and investigation are beyond the financial resources of persons or institutions. On the other hand, a number of research projects and investigations, particularly in the field of the human sciences, are likely to be very useful, if not necessary, to the welfare of society and should be included in the major preoccupations of the government organization. We feel it imperative, particularly now when the whole pattern of life is being rethought at all levels, that serious investigations and research into this field be given government support and that projects felt to be important be carried out successfully. To this must be added the necessity of providing adequate information on the possibilities offered both to individuals and institutions.

3. Publications

In many cases, it is difficult to succeed in publishing research as such publications are not financially profitable and may not be readily integrated within the ordinary budgets of individuals or institutions. Nevertheless, these publications may be of vital assistance, if not for the public, at least for persons helping to advance society and desirous of pursuing their research in a given field. Here again, public funds prove necessary for researchers and institutions which assume their services.

4. Institutes, Centres, Schools

A number of university agencies or others have sprung up during the past few years to study the problems of values; the family, health, morals, law, etc. These agencies do not always develop as rapidly as might be hoped due to lack of funds. Research at any level is rarely immediately profitable. It is in this area, principally, that universities or other similar institutions would consider government help essential if they are to attain their objectives.

Ottawa, February 21, 1969.

APPENDIX 75

BRIEF
to the
SPECIAL COMMITTEE ON SCIENCE POLICY
of the
SENATE OF CANADA

from
Department of Physiology
Queen's University
at
Kingston

One of the fundamental needs of any society is for facilities and personnel to care for the sick. In Canada, government has accepted the major financial responsibility for providing facilities for the delivery of health care and for the establishment and operation of institutions for the education of health care personnel. The Federal Government has assumed a leading role in discharging this responsibility and in recent years has passed two major pieces of legislation affecting the health sciences, one for the creation of Medicare and another for the establishment of the Health Resources Fund. That support for health science research is inseparable from and indispensable to the provision of adequate standards of medical education, health services and health care, has been recognized by the establishment of the Medical Research Council and the provision of a separate budget for that agency. The Liberal Party, in a policy statement issued prior to the last election, recognized the key role of science technology and research in the evolution of our society.

Numerous reports, the latest of which is "Medical Research in Canada, an Analysis of Immediate and Future Needs", (commonly referred to as the Gundy Report, December, 1965) have made it clear that expanded programmes of medical research are urgently required in Canada. Despite this well-documented presentation of the urgent need for increased support of medical research and the clear statement that the Liberal Party recognizes the current deficiency in such support, the present Government has announced that it will not increase its support

of medical research in 1969-70 in any way commensurate with the documented requirements. The spending estimates tabled by the Treasury Board on 4 February, 1969, provide for an increase of only 14.8% in the budget of the Medical Research Council to a total of \$31,273,000 for 1969-70; these funds will be insufficient to allow for the necessary progression of current research programmes in Canadian Medical Schools and support for new projects will be provided only at the expense of cancelling or grossly cutting back programmes already adjudged worthy of full support. Although the MRC budget was increased by approximately 33% in 1967-68 and by 30% in 1968-69 and there was an increase in funding to some other Federal agencies for health science education and research, the magnitude of these increases fell considerably short of the goals shown in the Gundy Report to be essential to the provision of good quality health care for the Canadian people. In the present atmosphere of austerity and with the announced intention of the Federal Government to reduce expansion in the Health Sciences field (as exemplified by the reduced rate of cash flow from the Health Resources Fund), we are deeply alarmed that cutting by half the rate of increase of funding for the MRC will inevitably produce a major short-fall in the budget of this agency in 1969-70. At this point in time we are convinced that such a short-fall in funds for the support of medical research will have devastating and far-reaching effects on the education of health science personnel and the ultimate delivery of health care in Canada. We deem it imperative not only that the rate of increase in the MRC budget be at least maintained at 30%

in 1969-70 but also that the true requirements for support documented in the Gundy Report be re-examined and given the highest possible priority in the current fiscal year.

It would be redundant to re-state the urgent requirements for increased support of health science education and research already documented clearly and exhaustively in the Gundy Report on Medical Research in Canada. This Report is as valid today as it was in 1965. It should be emphasized that this Report was endorsed by the Council of the Association of Canadian Medical Colleges, which represents the Deans of all Canadian Medical Schools. It was also officially endorsed by numerous scientific societies and by hundreds of medical teacher-scientists throughout Canada. It is clear that this Report expresses the opinion of medical research workers and leading medical educators in this country.

Our major concern is that government does not appear to appreciate the truly disastrous consequences of failure to implement immediately a realistic programme of support for medical research commensurate with the needs of the Canadian people. We are already faced with an acute shortage of health science personnel and the implementation of Medicare will make the shortage assume crisis proportions. Without immediate and major increases in research support, the Canadian medical schools will be increasingly unable to retain existing faculty members, to train future teacher-scientists or to attract from other countries the faculty desperately required to increase our output of health care personnel.

At present some American teacher-scientists have been recruited to fill faculty vacancies in Canadian medical schools because they are prepared to sacrifice adequate research support and the facilities and equipment necessary to conduct major research programmes for freedom from racial unrest and from compulsory military service. Dr. Walter MacKenzie, Dean of the Faculty of Medicine at the University of Alberta and past President of the American College of Surgeons, when discussing the emigration of Canadian scientists to the United States, stated bluntly in the Medical Post (31 December, 1968), "We wouldn't have half the faculty we have now since a lot of the good people we have been getting in the last couple of years have been people who very sensibly have decided that Canada, even with its lesser facilities, is preferable to Saigon. There is no question in the world that our recruitment programme has been aided and abetted by the local difficulties in the U.S. and, of course, that nasty war".

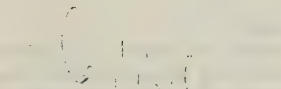
It should be emphasized that even a temporary reduction in the rate of increase in health research support which began in 1967-68 will have far-reaching results which will be apparent for many years because of the extended time necessary to build viable research programmes and to produce medical teacher-scientists.

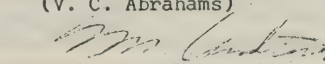
Effective research and the education of medical teacher-scientists requires that research programmes be initiated and conducted on a long-term basis with guarantees of continued support sufficient to allow for planned progress toward a research goal, the hiring of support personnel, and an orderly progression of experience and training for graduate students. A decrease in the rate of increase of research

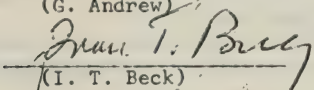
support through the MRC, of however short duration, will, at this point in time, destroy the continuum of many research programmes now reaching a phase of major productivity, interrupt the training of large numbers of graduate students and prevent others from beginning courses of training. Indeed, even the present atmosphere of austerity and the uncertainty concerning the adequacy of research support has made it difficult to recruit new staff and has necessitated a reduction in the numbers of graduate students accepted by many medical departments. The reduction in spending from the Health Resources Fund announced in 1968 was considered by many to reflect the attitude that Government does not consider support for medical research in a realistic way; this view has been confirmed by the recent announcement of the 1969-70 spending estimates for the MRC and other Federal granting agencies. The low priority placed on funding medical research constitutes, in our opinion, a lack of appreciation of the role of health science research in providing the Canadian people with good quality health care.

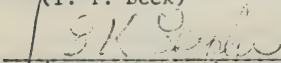
This brief is respectfully submitted by the Department of Physiology of Queen's University to the Special Committee on Science Policy of the Senate of Canada under the Chairmanship of the Honourable Maurice Lamontagne. The undersigned would welcome the opportunity to amplify and answer questions on the views expressed in this brief if it is considered appropriate for us to appear before the Special Committee.

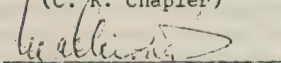
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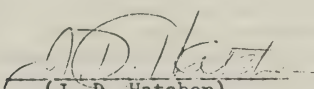

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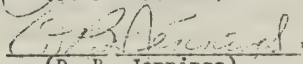

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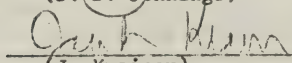

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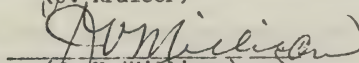

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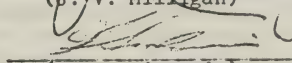

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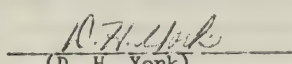

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Special Committee

APPENDIX 76

Brief submitted to the

Senate Special Committee on Science Policy

by

John C. Robertson, Jr., Ph.D. Assistant Professor

Department of Religion

McMaster University

March, 1969.

Religion and the Formulation of a Science Policy
in the Context of Higher Education¹

1. A genuine dialogue between religion and the physical sciences is possible of course only when the proper locus of their mutual concern is recognized. Much of the unhappy warfare between science and religion in the past has occurred when one or both of the disciplines overstepped its proper limits: that is, when religion became a crypto-science or science became a crypto-religion. To insure that the future of the dialogue is more fruitful than the past the legitimate spheres of competence need to be delineated and observed. For its part, religion must recognize its own non-competence vis a vis physical science qua physical science. This will involve recognizing that religion has no privileged data or conclusions to supply to science and it has no preferred scientific conclusions. In this sense, it recognizes the full autonomy of the scientific enterprise.

2. Yet it does not follow that religion and science must exist in a state of mutual indifference. To the contrary, a dialogue and confrontation between religion and science is both possible and desirable within the sphere of the values explicitly and implicitly involved with each. In this regard, the stance of religion vis a vis science must be dialectical.

2:1. To say that the proper stance of religion vis a vis science is dialectical is to say, on the one hand, that there is a positive aspect of the religious stance toward the physical sciences.

2:12. It is positive in the sense that religion recognizes and deeply respects the moral values implicit in and intrinsic to the activities of the scientific community as such. For example, religion notes the genuine loyalty to the cause of truth-telling that characterizes the scientific discipline. Also, religion admires the catholicity of interest innate to science; that is, against intellectual provincialism, science attends to and characteristically investigates a wide range of the created order. And then there is also the scientific attitude of respect for even the most uncongenial of facts, which attitude the religious moralist would interpret as the secular counterpart to humility and repentance. In light of this recognition, religion is concerned that the wider community of men also recognize and respect these values intrinsic to the activity of the scientific community. Practically speaking, religion is concerned, for instance, that the scientist's loyalty to the seeking and communicating the truth not be subjected to undue pressure by those who want him to corrupt, distort, or suppress the noble autonomy and integrity of his discipline for the sake of the imagined utilitarian considerations of this or that cause. Extreme instances of this pressure have been, obviously, the Nazi attempts to pervert the findings of anthropology, Communist pressures to bias

¹ In this paper "religion" will mean that system of beliefs and practices which revolve around the asking and answering of the question, "What is of ultimate importance to man qua man?" This is intended to be a generic definition not limited to any one particular religious tradition by "science" we are referring to the generic class of those disciplines devoted to the study of physical nature.

inquiries in genetics, totalitarian hostility to quantum mechanics and relativity physics, etc. One also notes commercial pressures against inquiries into the causes of certain types of illness, both physical and psychological (e.g., causes of cancer and the effects of television). Religion is also concerned with the pressures that perhaps unknowingly tend to make impossible theoretical science by demanding that the scientist justify all of his inquiry in terms of practical results. All of these tendencies and others must be resisted if the intrinsic values of science qua science are to be conserved.

2:13. Furthermore, religion recognizes and respects the instrumental values of science. That is, religion notes with admiration the commendable role science has played as a part of the broad human striving for the achievement of a more decent and humane state of man. It is clear that the physical sciences have helped considerably to make all of our lives less "short, nasty, and brutish." In light of this, religion is concerned to help scientists resist the many forces that would seek to bend scientific efforts to dehumanizing ends instead of ennobling ones. And religion is eager to be of what help it can to the scientist as he attempts to discern the appropriate practical ways his discipline may serve the human cause.

2:2. However, as the attitude of religion toward science is positive, on the one hand, it is, if not negative, at least cautionary, on the other. And it is hoped that this side of the dialectic will be taken as seriously as the other.

2:21. That is, while recognizing the genuine moral value intrinsically and instrumentally related to the scientific enterprise, religion must also insist that the value of science is a limited value, one value alongside of other values within the community of beings. Consequently, religion would caution against the dehumanizing effects of the absolutizing of science and the concomitant loss of a universal perspective. Instances of this absolutizing frequently are:

(1) The absolutizing of the scientific method, regarding it as normative and imperious in man's quest for the real.

(2) The absolutizing of scientific conclusions, failing to recognize that scientific truth is not the whole of truth and that truth itself is only part of a manifold system of values which includes also the values of justice and beauty.

(3) The absolutizing of the scientific attitude. This point especially requires further comment. The scientific attitude seems necessarily to be one that "objectifies" its data. While this seems to be necessary for science, one should note the possibility of at least two dehumanizing effects:

(a) The first is easy to detect. It is the tendency to see other beings only as means which derive their value by their potential contribution to scientific progress. Most blatant examples of this, for instance, would be the desire to invade the privacy of other beings in the name of science and the desire to use other humans as guinea pigs with something less than their absolutely uncoerced and fully informed consent.

(b) The second is less obvious and is more difficult to detect. Hence it is perhaps the more dangerous of the two. It is the illicit extension of the process of scientific objectification, which is licit only in a limited context, to all reality. Science often suggests (attitudinally at least) that only what is capable of being objectified is genuinely real. It often seems to suggest, for example, that persons are real only insofar as persons can be studied as objects, analyzed as public, external realities, that is, as "its". When religion, along with certain types of poetry and philosophy, protest against this reductionism they are ipso facto dismissed as being "unscientific", obscurantist, or merely "emotive". Religion then must deplore these tendencies and caution against the absolutizing of science. But this must be done in a way that neither gives comfort to the enemies of science within our culture nor gain-says the genuine limited value of science as a value among others.

3. The scientist cannot, however, be held solely to blame for the potentially dangerous effects of his discipline. Yet insofar as the scientist has been only a scientist and has not also been a philosopher (in the broad sense of lover of comprehensive wisdom) he has not been adequately aware of the limits and potentially dehumanizing effects of his discipline (nor perhaps, though less importantly, fully aware of its genuine values). Hence he has been, for this reason, unaware of the urgent necessity of the scientific discipline being complemented by the work of other disciplines committed to other methods and aspects of being, to other types of truths and values; and thus he has unwittingly conveyed the impression that his method, truths and attitudes constitute the whole of what is real.

3:1. Whatever the shortcomings of the scientist, the rest of us must bear part of the responsibility for the unfortunate influences of science in the modern world, for we have been content to be so ignorant of even the most elementary aspects of the scientific enterprise that we have not known how to assess, appreciate and complement the scientist's work.

4. In the light of the above theses, certain practical conclusions can be drawn:

(A) It follows from theses 2:12 and 2:13 that, while a broad governmental support of the scientific inquiry in the universities is desirable, governmental control is not. The value of more or less disinterested and theoretical inquiry must not be sacrificed for short-range goals or excessively utilitarian purposes. Further, the autonomy of scientific inquiry must not be distorted by heteronomous interests.

(B) It follows from theses 2:2 and 2:21 that particular care should be exercised in the education of scientists. For example, undergraduates majoring in science should not be allowed to concentrate so heavily in science that they neglect the more philosophical (again in a broad, nontechnical sense of the word) disciplines.

(C) In this context, we would urge that there is need for the full support of the philosophical disciplines and that in our concern for scientific excellence the "non-scientific" disciplines not be assigned a position of diminishing importance in university education.

(D) It follows from theses 3 and 3:1 that there is a special need for:

1) opportunities for non-specialists to be introduced to certain basic aspects of the scientific discipline and

2) the opportunity to develop inter-disciplinary seminars, studies, etc., involving scientists and representatives of the philosophical disciplines for the purpose of reflecting upon the nature and function of science within the context of wider humanistic concerns.

Appendix. Since the above is written from the standpoint of religion, some further clarification of the role of religion vis a vis science seems in order. In the last thesis above, it was suggested that such disciplines as religion should also receive general public support as a necessary complement to the support of science. This is not the place to do what has been done elsewhere, that is to explain what the academic study of religion involves, etc. But it should be repeated that those who study religion in the academic context do not confuse their discipline with "apologetics" or "evangelism"; rather, they simply desire to educate the public about the nature and function of religion within the wider human community and to make available to the public the wisdom of the religions as a contribution to the broadly conceived philosophical and humane concerns of all men.

March, 1969.

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Department of Religion
McMaster University
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APPENDIX 77

SCIENTIFIC INFORMATION IN NORTHERN ONTARIO

A B R I E F

to the Special Committee
on Science Policy
of the Senate of Canada.

presented by

LAURENTIAN UNIVERSITY

Prepared by

Paul-Emile Fillion, S.J., Chief Librarian

in consultation with

Dr. W. Y. Watson, Assistant Dean (Science) and

Dr. G. A. Rubin, Head, Physics Department

January 1969.

Special Committee

Laurentian University is deeply interested in the purpose of the survey conducted presently by the Special Committee on Science Policy of the Senate of Canada.

The relatively remote geographical location, the economic and social conditions of the area (resulting in part from the exploitation of natural resources rather than from extensive farming or secondary industry) might not be unique, nor the particular problems and challenges facing higher education and research in such surroundings. Similar observations will probably be expressed by other institutions and we hope that a common pattern of development can be evolved to bring to all Canadian citizens and firms a comparable level of availability of scientific information.

Laurentian University desires, therefore, to contribute fully to the aims and objectives of a National Science Policy by bringing to its teaching and research programme the best scientific documentation available in Canada and by playing an active role in the dissemination of scientific information in Northern Ontario and about Northern Ontario.

The considerations and recommendations we present to this survey might be grouped under three main headings:

- 1 - the organization and availability of scientific information, specifically adapted to Canada;
- 2 - the present role of universities, especially of the reference services of their libraries, in the gathering and dissemination of information;
- 3 - the specific contribution that Laurentian University can make to Northern Ontario.

ORGANIZATION AND DISSEMINATION OF SCIENTIFIC INFORMATION

We consider that the Government of Canada, through its various departments, should foster a policy of scientific information to include the following elements:

- a) the exercise of a strong role in sponsoring nationally and internationally, the wider and deeper indexing of world-wide scientific literature and its availability through appropriate publication, in printed form or otherwise;
- b) the creation of a national reference staff, familiar with all fields of scientific endeavours, to interpret and guide through the mass of indexed and non-indexed literature. Even very large universities and research centers can hardly provide such a pool of expertise;
- c) the development of a central computerized bank of data in all fields, and especially about the Canadian physical and social reality;
- d) the setting up of standards of format for data processing hardware and software to insure efficiency of the local systems and of the national network;
- e) the development of translation services for technical matters, available centrally and extending beyond English and French;
- f) the inception of a system of grants to permit remote centres to be served adequately, such help compensating for the absence of large research collections and highly specialized personnel.

PRESENT UNIVERSITY COMMITMENT TO INFORMATION SERVICES

Laurentian University is called upon to play a double role: that of providing higher education facilities and of serving the intellectual life and scientific needs of the area. Its first purpose is to offer young men and women the opportunities to obtain intellectual preparation and stimulation, whether they elect eventually to live in Northern Ontario or not. The present "formula financing", common to all Ontario universities, barely provides for reaching towards that goal. The commitment of the Library to this basic role restricts it then to the procurement of books and journals for the immediate needs of the teaching programmes and of limited concomitant research.

In the same way, the computer installation (IBM 1130, ultimately 360) that has been acquired is geared to the service of the university and is to be used as an administration and local research tool. The Library will use it for accounting-type procedures, possibly also as a bibliographical tool for cataloguing and reference purpose, dealing with subject literature rather than with detailed bits of technical information.

However, a regional university such as Laurentian constitutes also the ideal Documentation Centre for the area, a sub-station of a national network. The teaching and research staff of the institutions are prime customers of information; they belong to and form a substantial segment of the scientific and professional community of Northern Ontario which, in turn, regards the university as its natural bank of apt and accurate documentation.

The authorities of Laurentian University recognize this role of their institution in the complete development of Northern Ontario, from the exploration of resources to the integrated social development of its population.

If the principle of regional "Scientific Information Centres", based on existing academic facilities, is recommended as part of a National Policy, Laurentian University would prepare detailed projects and programmes. In order to provide appropriate, substantial, and responsible dissemination of scientific information, the University would set up a Regional Advisory Board to help in planning, and reviewing regularly, the Information Service and its operations.

As a tentative preliminary estimate, the cost could amount to approximately \$30,000 a year at the beginning, that is \$10,000 for acquiring specific books and documents (or photocopies) on Northern Ontario or on topics of special importance to Northern Ontario, plus \$20,000 for related processing and reference services. The provision of an appropriate system of communication (direct telephone lines to Ottawa, Toronto, Montreal, in addition to Telex), would allow the tapping of larger units of information and reduce substantially the possible duplication of materials and services. Similar arrangements between the Centre and the main Northern Ontario towns would permit more meaningful interpretation of requests and answers and also expedite service.

Unfortunately, Laurentian University cannot fulfill at present this larger role. Given appropriate financial resources, however, the institution could play its share in such a national information context.

SPECIFIC CONTRIBUTION OF LAURENTIAN UNIVERSITY

The first role of a Scientific Documentation Centre at Laurentian would be to channel information into the area, as requested, and to keep a record of it for future utilization. But a much more specific aim could and should be entertained, that of collecting in one central location as much pertinent information as possible on Northern Ontario for the benefit of the area and of the rest of the country. Also the Centre would have the responsibility of obtaining, preferably ahead of requests and in a systematic manner, the kind of documentation that would contribute more directly to the material and social improvement of the region.

In practically all fields of pure and applied sciences, as well as of social sciences, are to be found aspects that are peculiar in some way to Northern Ontario.

In the vast field of ecology, there is need for central information about the meteorology of the region (temperature, precipitation over a number of years, etc.); air and water pollution (including radiation); local flora and fauna and its applied aspects (e.g. conservation practices of the "Northern" regions or countries).

Geological, mining and, increasingly, metallurgical information on the region or as applicable to the region, is another constant need. This involves also specific problems in chemistry, physics, engineering. Applied mathematics, especially through statistical data and their interpretation, provides a link between the natural and the social sciences.

In human ecology, the need for scientific information is much greater.

The preservation of Indian culture (which supposes archaeology and cultural anthropology) and the meaningful integration of Indians into the region may be listed among the priorities. Instances of past, present, and possible characteristic contributions of the Indian population to Northern Ontario and to Canadian society should be recorded.

Then, the human problems of settlements, as applied to the region, should be documented: urbanization of small and scattered communities, housing (type, standards, costs); public services (federal, provincial, municipal, educational).

The long-range planning for this region rests on accurate documentation. It involves data on transportation in the area (train, bus, air, roads) and the impact on commerce, schooling, etc.; there are pockets of chronic poverty, and there are isolated communities; there are assets to be developed considerably, especially tourism; the cost of services (domestic and public) relatively to other parts of the country has to be explored and taken into account, etc.

The documentation collected in and about Northern Ontario and concerning similar natural and social conditions in other parts of the country and of the world, would soon constitute the background for a substantial programme of "Northern Ontario Studies" to be developed at Laurentian. In turn, the research preoccupation of students and faculty could become increasingly oriented towards Northern Ontario and contribute positively to the betterment of the region.

Thus, the Laurentian Documentation Centre would achieve the basic objectives pursued by your Committee.

APPENDIX 78

Brief submitted to the

Senate Special Committee on Science Policy

by

Research Advisory Board

University of Guelph

February, 1969.

Introduction

In this report reference is made for purposes of convenience to three major groups: the natural sciences, the social sciences and the humanities. It should be understood that engineering, agricultural science and veterinary medicine are included for these purposes under the natural sciences and that all the creative activities associated with the humanities are included.

It does not seem necessary to comment on the broad aspects of the significance of research and other forms of creative activity in the sciences and the humanities. The key role played by these activities in the past and their potential for improving the wealth, culture and well-being of a society is well documented. Also, the general problems and needs facing the different areas have been well documented.

The increasing role played by university graduates with higher degrees in shaping the economic, social and cultural welfare of Canada is placing an increasing responsibility on the universities. At present there is a shortage of people trained at the graduate level in the sciences and humanities. In some areas the gaps are being filled by personnel induced to come here from other countries but this cannot be relied on as a permanent source; in other cases there are positions that cannot be filled; and under such conditions of shortage it is likely that some positions are being filled by persons with less than the ideal qualifications for the greatest productivity. The demand in this country for graduates with advanced degrees is increasing rapidly. Hence it is imperative that Canadian Universities continue to expand rapidly in the area of graduate training and research.

One of the greatest needs at the universities is funding for research. Good graduate schools flourish only in those universities deeply involved in research - an environment in which the faculty are able to carry on a significant volume of research of all types including a large share right at the frontiers of the unknown. To accomplish the necessary expansion in graduate training and research the universities must have a level of funding substantially above that available in the past to supply the sophisticated and often costly equipment, the supporting staff, and the support for graduate students being trained in research methods and conducting research.

Dramatic increases have occurred in recent years, and are projected, in numbers of faculty members as a result of increases in student numbers at universities. This increasing number of faculty, combined with the increasing number of graduate students conducting research, means that there is a rapidly expanding research potential at the universities. Research from this source can play an increasingly significant role in the total research effort in Canada, provided the funds are made available to exploit this potential.

I. Goals for the Federal Government in the Support of Research

A national policy for research is an essential base for the development of a rational and effective program of support for and encouragement of research in each of the three major research agencies - government, university and industry. The need is based on three general considerations.

- (a) Economic progress. It is economically necessary, if Canada wishes to retain and preferably improve her competitive position in the North American and world economies, for Canada to establish a level of technology that will assure this. It is well recognized that the level of technology in a modern nation to a large measure establishes the productivity and competitive ability of that nation.
- (b) Geographical location. The special geographic location of Canada between two major industrial and political powers that emphasize science and technology - the U.S.A. and the U.S.S.R. - and the great area of this country relative to population density, pose special problems and opportunities for Canada. These special considerations must be reflected in the research policy, research organization and research activity in Canada.
- (c) Social welfare and cultural development. Continuing consideration must be given to the environment in which man is placed and expected to live in harmony and produce efficiently. The nation has a responsibility to attempt to understand man and his reaction to different components of the environment and to provide an improved environment for living, working and leisure. Research in the health sciences, social sciences and humanities plays a vital role in this area.

In the development of a national policy for research the following principles should receive careful attention:

- (a) The Government of Canada must be responsible for seeing that a national research policy is developed and maintained under continuing review. In order to do this a body should be established, composed of persons qualified in the major areas, i.e. humanities, social sciences and natural sciences, and drawn from governments, universities, industry and the community. It is essential that universities have strong representation on this body.
- (b) Areas for intensive research in Canada should be selected on the basis of those most likely to increase gross national product and those most desirable for the health and welfare of the people.
- (c) In addition to the areas chosen for intensive research, all areas important to the nation should be provided with at least a minimal number of research, personnel and a moderate level of research. This will assure a bank of qualified personnel who can interpret new developments so Canada can capitalize fully on the research done in the rest of the world.
- (d) Level of research and development needed to reach the socio-economic goals of the nation must be established.
- (e) Balance among fundamental research, applied research and developmental activities to achieve these goals must be selected.
- (f) Location of the research and development for effective use of the funds funnelled into research and development must be determined.

Canada cannot provide enough funds for fundamental and applied research to permit the luxury of the dispersion of these limited funds to a multitude of small research centres. It would seem desirable to consolidate research by maintaining only research units of a size which assures viability in modern research. The primary units that need to be supported to the level to make them strong are the universities because of the dual role they perform for Canada - the training of the scientific personnel and the production of research results. Science in Canadian universities has not been adequately funded to allow the universities to discharge these functions at the level necessary.

- (g) Location of sufficient research at universities is necessary to provide a strong base for producing the scientists necessary to man the Canadian research and development units. It is important that policy be developed so that the professional manpower required to meet the national objectives will be available.

- (h) Provision for the compilation of information which might affect policy decisions in research and development and to make this available on a continuing basis to all agencies involved in research and development should be considered. This should involve developing and making available an information retrieval system to supply information on request to Canadian industries, government, universities and others involved in or planning research and development.

It is essential in the formation of science policy to establish the role of each of the main agencies - government, university and industry, in research. The general views of this University are as follows:

Role of Government in Research:

- (a) Government is responsible for guiding the development and welfare of the nation (federal) or province (provincial) so must take the lead in encouraging the development of the technological competence and cultural development of the nation or province. Governments at both levels-federal and provincial, are deeply involved and both must assume part of the responsibility. The federal government, however, must take the lead in developing and maintaining the national policy for research involving the provincial governments and other interested groups.
- (b) The Government of Canada will need to control the level and type of research in the area of national defence. Some of this research can be conducted by industries and universities and some may be done best in government laboratories.
- (c) Both levels of government - federal and provincial - should play an important role in stimulating research and development activities. The federal role must be the major one because research is so vital to the nation as a whole. It can stimulate research in the universities through provision of adequate funds. Stimulation of research and development in industry is possible through such means as direct provision of funds, tax rebate incentives, accelerated depreciation allowances, subsidies and patent protection.
- (d) The role of governments in intramural research is one that requires careful scrutiny in Canada at present. Federal government support of research through research in its own laboratories has been high relative to its support of research in universities and industry. This has been a significant factor inhibiting the required growth of research in universities and research and development activities in industry.

There are areas of research that should be conducted by the federal government in its own laboratories, i.e. certain national defence problems, regional research for resource use which cannot be undertaken by provinces, etc. After the above requirements are met the goal in organizing the additional research should be to support as much of it as possible in universities and industry.

The existing federal and provincial government research laboratories certainly should be continued because all research resources now in existence are needed. However, each expansion in intramural research contemplated should be assessed carefully to see where it could fit most effectively into the total picture. When a decision is made to establish a new government research unit, it is strongly recommended that this unit be located so it can be integrated easily with the research and training programs of universities.

Presumably most of the governmental intramural research is relatively closely mission-oriented, mainly applied and includes a small developmental component. Consulting for industry should be an important function of the scientists in government research laboratories.

Role of the University in Research:

The role of the university is discussed in more detail in Section II.

The main points in the research role of the university are:

- (a) Much of the research should be fundamental, aimed at producing new knowledge on a broad front.
- (b) A considerable portion of the fundamental research can be concentrated in selected areas, i.e. broadly mission-oriented. A national research policy would be studied by the universities and clearly would effect a special concentration in high priority areas.
- (c) Applied research of a mission-oriented nature should be conducted in the university to the mutual advantage of the university and the nation.
- (d) Consulting activities on the part of the faculty should be provided. This activity is valuable to the program of the university and of real significance to industry.
- (e) Development research activities should not be carried out in any volume by the university.

Role of Industry in Research:

- (a) Industry should play a major role in applied research and the dominant role in developmental research activities. Neither is well developed in Canada at present. Most of the industrial activity in this area deals with development although some industries have very significant basic and applied research programs. A major goal of a national research policy should be to encourage an increase in industrial research and development.
- (b) Highly developed industrial research programs will have a content of fundamental research but generally, such research is broadly mission-oriented. Canada has little such industrial research at present. An expansion of co-operative ventures in this area between industry and university, and between industry and government research laboratories would appear feasible and highly desirable.

II. The Objectives of the University in Conducting Research

The primary objectives of the universities, which they wish to achieve through intramural research, are three:

- (a) to help push back the frontiers of knowledge.
- (b) to produce the next generation of scholars who in turn will push back the frontiers even farther.
- (c) to provide the community with the educated men and women equipped to take their place in all walks of life.

The output of Canadian graduate students is inadequate to meet the needs of the current level of research and development and must be increased substantially to meet the increasing needs. It is essential that research at Canadian universities be well supported and strong in order to interest students in pursuing careers in the natural sciences, social sciences and humanities, to encourage high calibre students to pursue postgraduate studies, and to encourage high calibre researchers to remain in Canada and serve at the universities where they can have an influence on the future personnel and on the calibre of Canadian research.

Objectives of the University in Training:

- (a) the graduate education program at the universities should be designed in size and content to produce the natural scientists, social scientists and humanists needed for Canada. Research is an integral part of this manpower training program.

- (b) Graduate training programs have as their primary objective the education of students in research methods. Hence the overriding criterion in the selection of a research topic by the graduate student must be the suitability of the topic for the training of that student.
- (c) Fortunately, by careful thought, a topic usually can be selected that will meet this criterion and at the same time produce new knowledge. This is especially so at the doctoral level. As a result the research conducted by graduate students for their theses is an important source of new knowledge.
- (d) With the increase in graduate students projected for Canada, the volume of research from this source is of increasing significance relative to total research in Canada.

Objectives of the University in Scholarly Work:

- (a) The university setting is ideal for fundamental research aimed at extending the theoretical background for scientific and technological progress as well as the advancement of knowledge in general. This type of research fits in well with the training program for the majority of graduate students, especially doctoral students, and fits in well with the personal research program of the majority of faculty members.
- (b) The university campus in Canada should be a major source of the new fundamental knowledge produced in Canada in most areas.

Objectives of the University in Applied Work in the Public Interest:

- (a) Universities should accept an important role in applied research. Canada should establish a research pattern which assures that the results of fundamental research will move quickly through the applied research phase to development and use. One aspect of this pattern would be to establish applied research programs at all centres where there is a volume of fundamental research being conducted and where there is a high level of expertise in theory. Under the proposals made herein the universities would be the centres for a major portion of the fundamental research effort of Canada. Hence universities must, if they wish to be the major fundamental research centres, accept the responsibility for a relatively large amount of applied research. In operation this would mean that some university faculty members conduct fundamental research, some a combination of fundamental and applied, and some applied research. The separation of research into fundamental and applied is based on a fluid line of demarcation and there can be, in fact, no clear line. For example, in the social sciences, it is very difficult, if not impossible in many cases, to separate research that is associated with the expansion of the frontiers of knowledge from the application of such knowledge to the problems of the community as a whole.

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- (b) An applied research program as part of the total university research program geared to meet the special needs of the Canadian scene will play an important role in feeding new problems into the fundamental research program and thereby increase the effectiveness of that program.
- (c) The university graduate education program should be geared to produce the personnel to do the fundamental research in Canada. Of equal importance, it should be geared to produce the personnel to fill the need in mission-oriented research and development units operated by government and by industry. The presence of both an applied and a fundamental research program at the university creates a more suitable environment for the educational programs of students preparing for careers in fundamental and in mission-oriented research. The scientist that emerges from such an environment should be reasonably aware of the total scientific community of which he is a part.
- (d) There should be no significant amount of development work at universities. Any development work that is needed beyond that done by industry should be done in government units.

III. Allocation of Funds to Various Types of Research

- (a) Present allocations
 - 1. The general level of funding research in universities is too low to make the most effective possible use of existing faculty and physical resources and to meet the objectives in II.
 - 2. The cost of equipping a new research unit is high. New research units at emerging universities and new units within established faculties need sizeable equipment grants to initiate programs. Under the present system of funding it takes too long to equip such units.
 - 3. Young faculty members who have just completed their graduate training and who are well trained in up-to-date techniques, full of ideas and enthusiasm and anxious to initiate research, experience difficulty in getting enough research funds to launch a major program, in contrast to a small program.
 - 4. More funds are needed to support technicians and other assistants in all universities. There is a special need in those universities where the number of graduate students is low relative to the number of faculty. Provision of adequate funds for personnel to assist in research will allow the faculty members to be more productive, and perhaps relieve the pressure to initiate graduate programs with inadequate resources.
 - 5. Higher levels of graduate student support are needed to encourage a larger number of able students to proceed to graduate studies.

(b) Suggested changes in proportions allocated to various purposes

1. The general level of research expenditures as a percentage of gross national product in Canada is low relative to that of the United States and Sweden as clearly pointed out in the "Canadian Policy for Research and Development" statement by the Engineering Institute of Canada (1967). This also holds relative to the United Kingdom, Japan, The Netherlands, France and Germany.

There does not appear to be excessive research in any subject matter area in Canada. Hence, in discussions of research balance, it is extremely important to establish as a base that research should not be reduced in any area in order to divert the dollars to build up research in an area clearly in deficit at this time.

2. Increases in intramural research by government should be held to a minimum because of the disproportionate amount of such research in Canada at present which is restraining adequate research development in universities and industry.

3. Universities should be allocated a higher proportion of the government funds for research in order to:

(f) develop adequate programs to produce the large numbers of natural and social scientists and humanists with graduate training needed in Canada,

(ii) supply the research funding for the increasing faculty numbers so these resources can be fully exploited.

(iii) develop special programs to meet special research needs of Canada at this time, e.g. Industrial Research Grants from government to establish an industrial research program at a university.

4. Government policy should encourage industry to expand corporate expenditure on research and development.
5. Research in the social sciences and humanities, historically at a low volume in Canada, has recently begun to move up in volume. Care must be taken to nourish this significant development and provide the necessary sums of money to develop comprehensive research programs in these areas.

(c) Mechanisms for reviewing and determining present allocations

The main comments on this are in Sections VI - VII. The following two points apply to grants-in-aid as they now exist:

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1. Policy decisions which result in changes in the proportion of funds to be allocated to each area of research should be publicized widely to research organizations well in advance of the date on which applications are due.
2. A report back to the unsuccessful applicant indicating the reasons why the request could not be granted would be desirable.

IV. Scope of Support

(a) Grants-in-Aid or Full Support

The common form of grant-in-aid (modified to include indirect costs) which supplies funds for costs other than salary of the faculty member is a satisfactory system only when the funds being allocated are small. This is not efficient as the only system for the support of research at the level required for most effective use of the research potential in universities.

(b) Indirect costs

It is essential that indirect costs be supplied. If the research level is very low this is not of major concern. However, if the Canadian policy is to make effective research use of the scientific manpower at universities, the volume of research at universities will not be at this very low level. In such circumstances the indirect costs associated with the research will be far more than the universities can bear, and a supply of funds to cover indirect costs becomes mandatory.

The indirect cost level of 30 per cent suggested in the Bladen Commission report is too low. Sixty per cent is recommended. The indirect cost level at the University of Guelph is 42 per cent in 1967-1968 and this will increase in subsequent years because of the new facilities coming into use which will provide more research facilities per faculty member and therefore a higher level of indirect cost for maintenance.

- ##### (c) The Federal Government should assist in costs of training for research by providing, through its granting agencies, funds to support the research associated with the graduate programs. This support would take the form of graduate stipends, research equipment, library and operating costs, special installations for use both for graduate student and faculty research, and funds for computer facilities.

(d) Kinds of Grants Required for Graduate Student Training

1. It is strongly recommended that the system for distributing funds to provide graduate student stipends be based on a quota established for university with the funds provided as a block grant to the university with the decisions on awards made the responsibility of the university. The block grant would provide funds for the graduate stipend only. Other costs associated with the graduate student program should be provided for in the provincial grant to the university for the educational program of the university.
2. To encourage outstanding students to pursue graduate studies, a university should be free to use up to 20 per cent of its total grant for prestige awards to these outstanding scholars at a stipend level 30 per cent above the general stipend level.
3. Higher levels of graduate stipends are needed to encourage an adequate number of high calibre students to proceed to graduate study and research. The stipend level should be related to the average starting salary received by graduate at each level of academic qualification, e.g. at present the relationship might be one-half for the average student and 20 per cent above this level for the outstanding student.

(e) Kinds of Grants Required for Research by Faculty

Five types of grants are needed for general research support:

1. Grants-in-aid to individual faculty members should be continued with provision for an increase in total funds available to provide for:
 - (i) grants to increasing number of faculty resulting from the rapid growth of universities.
 - (ii) indirect costs incurred in using the grant-in-aid.

A very substantial increase in level of such funds should be provided in the social sciences and humanities area to bring these areas up to a funding level similar to that in the natural sciences.

The grant-in-aid should cover the costs of equipment, operating supplies, travel, and supporting personnel - non-technical, technical and professional, including postdoctoral assistants. In circumstances such as certain research in the humanities, which requires the researcher to spend considerable time off campus using special library collections, the grant should provide for part of the additional cost of living incurred by the researcher.

2. Block grants for research awarded to the university should be made available as soon as possible. These should in time become a major part of the government system for supplying research support to universities. Perhaps a suitable goal would be to have the amount of funds supplied in this manner equal the amount supplied through the grant-in-aid component by the end of a five-year period after the introduction of the block grant plan.

The block grant system should include two components:

- (i) Component A: A sum of money should be provided to the university to cover direct and indirect costs of blocks of research which the university would describe in the applications submitted. Research would be described in relatively large blocks, i.e. a program of a department, of a group within a department or of an interdepartmental group. For example, the university might describe the research program proposed for a department as a whole on the basis of a three- to five-year projection including in it information such as: objectives of the program; general plan for the research indicating the areas being given greatest emphasis; faculty resources - number participating in the research, teaching load, academic qualification, publication list, etc.; supporting staff - number, qualifications; number of graduate students and postdoctoral fellows - current and projected; physical facilities available.

The university would supply also an annual report of progress in each block of research including a narrative and list of publications. The university should be provided with assurance, that, under normal conditions, the support for a block of research will continue from year to year. In the occasional case in which the granting body wishes to phase out support of a particular block of research, there should be a phase-out period of at least three years.

The funds granted to the university for a particular block of research would be assigned to the research group described in the application, and would be used by that group in the manner most effective to accomplish the research goals.

- (ii) Component B: A sum of money, 10 per cent of the salaries of full-time faculty members, should be provided annually to a university for the general support of research to be used for any aspect of research within the university as determined by the university. This component is the "sustaining" grant recommended in the report of the Bladen Commission.

Component A of the block grant would provide the university with a significant budget for research and, therefore, the faculty members with a better base for planning their research. The grant-in-aid system is reasonably satisfactory when the funds to be granted are small but when the level of funds reaches that needed by Canadian universities for research during the next decade, the system becomes cumbersome and inadequate.

3. Grants are needed to develop and maintain an adequate data processing and computing system for the use of universities. Each university requires a basic unit, the size and sophistication depending on the program of the particular university.

Also essential is access to large computing installations which provide specialized consulting services for very sophisticated problems and facilities to handle the large volume of data processing and computing associated with special research programs. For example, the social science area has urgent need for a large scale data bank.

4. Library grants are essential to develop and maintain reasonable library holdings for research at the universities. The Spinks Commission report highlights the library problem in Ontario. It is a severe one and a major barrier to the expansion of graduate training and research programs in Ontario.

The shortage in library holdings in Ontario in 1966 estimated by the Spinks Commission is 4,790,000 volumes. The cost of removing the shortage in terms of 1967 dollars is approximately \$97,800,000.

Good library holdings are as essential to good research as is good laboratory equipment. Therefore, it is valid to expect the agencies supporting research to provide library support for that research.

New universities and new programs developing in existing universities have particular difficulty in finding adequate funds to build up the library to the critical point at which graduate programs, especially those at the Ph.D. level, can be initiated. Library grant policy should take into account the special needs of such emerging research units.

5. Special capital and operating grants should be provided to a university for unique research installations and units. In some cases such facilities may be for the use of one university and in other cases may be located conveniently for the use of several universities and perhaps other research groups.

The grant should cover capital costs and the salaries of the professional and non-professional personnel and other direct and indirect costs associated with the special unit.

(f) Contract Research

Contract research has a place in the university but it should not dominate the university research program. Selected contract research is valuable in making efficient use of the national research resources by more fully utilizing the expertise of particular research groups. It has the advantage to the university of increasing the volume and scope of research on campus and of creating a research environment exemplifying the range of the types of research conducted in society.

V. Liaison Between Universities and Government Research Establishments

It is essential from a national standpoint for the maximum productivity from the research investment to have a close liaison between government and university research units.

It is extremely desirable from the viewpoint of the university that there be a federal policy so that professional personnel in government research units might be available to assist in the training of graduate students, especially in areas in which the federal research laboratories have unique strength not at the universities. It would be an error, though, to develop graduate student training as a major responsibility of the government intramural research laboratories.

VI and VII Review Procedures and Proposals for Organization
Plan for the Federal Support of Research in Universities.

- (a) A ministry should be established in the federal government with responsibilities for research in the areas of the natural sciences, the social sciences and the humanities.
- (b) An advisory body composed of persons qualified in the major areas, i.e. humanities, social sciences and natural sciences, and drawn from government research agencies, university, industry and community, should be established with responsibilities for advice with respect to:
 - 1. the establishment and continuing review of a national policy for research in the humanities, social sciences and natural sciences,
 - 2. the level and proportion of funds required for research in the three areas,

3. the policy and procedures for encouraging research and development in the three areas and for distributing federal funds in support of research and development.

- (c) There should be a council formed for each area, i.e. natural sciences, social sciences and humanities, with membership from government, university, industry and community where appropriate, with responsibilities for assisting the advisory body in carrying out its functions.

The natural science council should operate through several committees or councils based on area of application, i.e. health sciences, agriculture and food, engineering, etc., and one or more dealing with certain fundamental areas and other important areas not covered by the committees (or councils) formed on the basis of area.

APPENDIX 79

Brief submitted to the

Senate Special Committee on Science Policy

by

Division II of the Faculty of Arts

of

Carleton University

This brief has been prepared by representatives from the Departments of Geography, Political Science, Psychology and Sociology-Anthropology. Although some of these disciplines have degrees of overlap of interest with the physical and life sciences, the brief has been designed with the specific purpose of speaking on behalf of the social sciences with respect to Federal Government assistance to research and development in the universities.

It has been estimated for the decade 1966-76, that the growth of social sciences at the graduate level will triple, both in terms of number of graduate students enrolled and number of new staff acquisitions. By the end of this decade, a preponderance of the research in the social sciences will be done within the university setting. It is therefore apparent, in the light of these projections, that significant increases in funding will be necessary. This responsibility will rest primarily with Federal granting agencies, the resources of the provinces already being heavily overburdened with costs of undergraduate programs. In addition, social scientists may no longer rely on U.S. granting agencies for support, this source having in the past constituted nearly 50% of the total research funding in certain disciplines. Should the Federal Government falter, graduate training in the universities would become more and more vulnerable to provincial and student pressures. Such pressures

might adversely affect the quality of postgraduate education in Canada. As a result, an even more serious gap between the quality of research facilities here in Canada and those in the U.S. might develop, with staff and students emigrating and thereby reactivating the "brain-drain" phenomenon. Already approximately 50% of social scientists in Canadian universities are non-Canadians, and should they return to their own countries, for whatever reasons, we would be left grossly understaffed. There is therefore an obvious and pressing need for training more Canadians at the graduate level under conditions which would encourage them to remain here.

Canada is currently faced with a multitude of problems in the areas of mental health, transportation, housing, the economy, environmental pollution, northern development, foreign policy, the use of our natural resources, regional disparities, urban growth, and national unity, to mention only a few problem areas. The social scientist, given adequate facilities, has much to contribute to the solution of these problems. His methodology will be both basic and applied in nature, and he often will be required to collaborate with physical and life scientists. A viable science policy must therefore emerge soon, and to help facilitate this formulation, we make the following seven recommendations.

1. An increase in federal funds for social sciences proportional to the projected expanded growth. These funds would be allocated as they have in the past to students in the form of bursaries and scholarships as well as to staff through grants-in-aid of research and postdoctoral fellowships. We do not wish to imply

the existence of a dichotomy between support for graduate students on the one hand and for research projects on the other. These activities are mutually interdependent, and adequate support for both is absolutely necessary for the creation and maintenance of successful graduate programs. We would also recommend the provision of funds for staff on sabbatical leave as well as for those engaged in fieldwork research.

2. The federal granting agencies should provide financial assistance to cover the substantial overhead costs of federally sponsored research and training projects. This is now a well-established practice in the U.S. These costs present an ever increasing strain on provincial governments, especially those which are less well financially endowed. Should overhead assistance not be provided federally, the provincial governments might well consider imposing severe fiscal restrictions on federally supported projects. By setting ceilings on costs of overhead, the provincial authorities would seriously constrict the development of graduate programs in Canada.
3. A realistic representation of social scientists on the Canada Council, the members of which would be responsible for maintaining an equitable distribution of funds across the various social science disciplines and who would be expected to encourage the development of graduate training facilities in the less affluent university centers. This division of the Canada Council, if adequately funded, would also help narrow the gap in research support which now exists between the social sciences on the one hand and the

physical and life sciences on the other. It would also ease the present conflict encountered by scientists within certain social science disciplines who do not clearly qualify for support from either NRC, MRC, DRB or various other agencies.

4. The Federal Government, like their U.S. counterpart, should begin providing compensation for individual research investigators. This would take the form of summer research stipends, occasional salary supplementation to relieve scientists from their teaching duties for short periods of time, and the creation of research chairs.
5. The establishment of research institutes and field stations where academics and others could concentrate, frequently on a long-term basis, on interdisciplinary approaches to the solution of problems in the aforementioned critical Canadian problem areas. In certain cases, the cooperation of provincial and municipal authorities would be desirable. Research libraries, and computer centers with time sharing arrangements, would be necessary integral components of such institutes.
6. Federal Government departments should expand their extramural research programs to include the universities wherever possible. This could be facilitated by the creation of a board consisting of the research directors of relevant federal government departments. This board would function as an intermediary body between federal granting agencies and principal research investigators in the universities.
7. There should be closer ties between the Federal Government and

the two universities located in Ottawa. This physical contiguity creates an ideal situation for the exchange of research ideas, professional staff and students in training. Carleton University and the University of Ottawa have, for several years now, maintained liaison by contributing substantially to the education of members of the Public Service of Canada through their Extension divisions.

Dr. P.J. McCormack (Psychology)
Mr. G. Bruce Doern (Political Science)
Dr. J.P. Johnson, Jr. (Geography)
Dr. Stephen Richer (Sociology and
Anthropology)

APPENDIX 80

Brief to the Government of Canada
The Special Senate Committee
On Science Policy

Submitted by the Department of
Computer Science
University of Western Ontario

March 14, 1969.

SUMMARY OF BRIEFTOTHE SPECIAL SENATE COMMITTEE ON SCIENCE POLICY1. Objectives

The objectives of a National Science Policy for Canada should be:

- (a) To increase greatly the number of scientific, engineering, and technical jobs available to Canadians.
- (b) To aid in regional development within Canada.
- (c) To equip Canada to provide scientific and technical leadership to underdeveloped countries of the commonwealth and the French Union.

2. Means of Accomplishment

These foregoing objectives may be realized in the following ways:

- (a) Balance the national research effort; that is, increase the amount of applied research and development performed in Canada while maintaining the quantity and traditional excellence of the basic research presently done by Canadian universities. The national effort in research can be increased significantly by the work of projected new Government institutes (to be described in this brief), while the desired increase in development can best result from an interplay of public and private resources in imaginative new industry-university complexes.
- (b) Provide for systematic, large-scale acquisition and management of scientific and technical information and its dissemination to Canadian industry.
- (c) Establish a vital and energetic national standards programme to promote consumer protection, compatibility of technical material used in industry, and acceptance of Canadian manufactured products in the export trade.
- (d) Develop and operate a nationwide high-speed computer-based telecommunications network, possibly using artificial earth satellites in stationary orbits, to reach all population centres, however small or remote, and facilitate the interchange of scientific and administrative data and information, educational television programming, computer-aided-instruction sequences, and computer-aided-design programmes for use by Canadian industry.

- (e) Initiate an intramural applied research programme in cybernetics and systems science furnishing support to the universities for the required basic research in the mathematical sciences and to industry (including consulting firms) for developmental effort in computer programming and applications in operations research, industrial computer science, and regional planning.
- (f) Initiate a corresponding applied research programme in materials science furnishing support to the universities for basic research in chemistry and solid-state physics and to industry for developmental effort aimed at propagating an indigenous Canadian electronics industry.

3. Implementation

It is suggested that the foregoing programme be implemented by a cabinet-level Department of Science and Technology which should include the following:

- (a) Representation of the National Research Council at the Ministerial level.
- (b) Liaison through the Deputy Minister's staff with the Defence Research Board, Agricultural Research Stations, Atomic Energy of Canada, Ltd., and Telecommunications of Canada, Ltd. (a Crown Corporation to be established to develop and operate the national telecommunications network mentioned previously).
- (c) The Institute for Scientific and Technical Information.
- (d) The Institute for Cybernetics and Systems Science.
- (e) The Institute for the Materials Sciences.

BRIEF TO THE SPECIAL SENATE COMMITTEE ON SCIENCE POLICY

1. The basic objective of any national science policy is to further national aspirations that may be diplomatic, military, eleemosynary, or economic. Economic objectives may include providing a national technological infrastructure or stimulating edogenous economic activity.
2. The most appropriate objective of a national science policy for Canada at this time would seem to be furthering her economic and diplomatic aspirations. The wealth of a nation is related to its level of scientific sophistication since it depends upon the output per man-hour: of value added to its products or services, and value is most readily added by scientific and technical workers. Furthermore, it is desirable that a nation's wealth be broadly distributed among its centres of population. It follows, therefore, that the national science policy should further Canada's national economic objectives by:
 - (a) Increasing the Canadian content of goods and services supplied or consumed in terms of scientific, engineering, technical, and skilled labour.
 - (b) Contributing to Canada's regional development.

The national science policy should further Canada's diplomatic objectives by providing the ability to furnish scientific and technical leadership to underdeveloped areas within the Commonwealth and the French Union.

3. The industrialized nations of the world can be grouped into three classes:
 - (a) The scientific leaders: the United States, the Soviet Union, Japan, the German Federal Republic, and the United Kingdom.
 - (b) Second-class scientific countries: France, Italy, Sweden, the Benelux countries, Switzerland, the German Democratic Republic, and Hungary.
 - (c) An upwardly-mobile group including, but not limited to: Israel, the Chinese People's Republic, and India.

Overall, Canada ranks about midway in the second group.

4. In Canada, basic research is done primarily in universities, which is true in most countries except the Soviet Union, where it is done in the various Academies of Sciences.

Canadian applied research is performed by Crown Corporations or Government departments, in universities, and to a small extent, by industry. In the United States and the United Kingdom applied research is done in national laboratories, industrial laboratories (often under government aegis), and in universities.

in Canada, development is carried on principally in Government laboratories. In the rest of the world it is done primarily in industry—even in the Soviet Union where Ministries responsible for production carry on developmental work in their factories or in special laboratory establishments.

5. Canadian basic research has been noteworthy largely in the fields of mathematics, atmospheric studies, medical science, and physics. Productive applied research has been done in nuclear energy, agriculture, health, and computer science. Development programmes have been mounted with some success in the fields of defence, construction, and transportation.

The branch-plant problem has contributed to Canadian weakness in applied research and development as well as to loss to emigration of Canadians trained in engineering and science. Weakness in industrial engineering and operations research occasionally has forced closing of certain branch plants; their owners having delayed developing and installing modern production methods until the plants became uneconomical even with relatively low prevailing wage rates.

Other symptoms of inadequate research effort as reflected in Canadian industry include:

- (a) The almost complete absence of a native Canadian electronics industry.
 - (b) Large-scale activity in the crude extraction of metals (ferrous, non-ferrous, and exotic) from ores but little corresponding activity in refinement of metals and production of technologically novel and important alloys.
 - (c) Heavy dependence upon U.S. computer manufacturers for programmes (software) widely used both in scientific computation and data processing.
 - (d) Negligible activity in design and production of high-speed aircraft.
 - (e) Inadequate national communications facilities for real-time interchange of information at high data rates. Requirements for this service are especially high in remote regions of Canada where they are needed to facilitate educational services (educational television and computer-aided-instruction) and scientific data collection.
6. Broadly speaking, the national science policy should accomplish the following:
 - (a) Fill gaps in the existing science programme by salient attacks upon selected disciplines at levels not presently reached by efforts of industry and the universities.

- (b) Provide assistance to the universities in critical disciplines by means of scholarships, fellowships (including travel and work abroad), sponsorship of visiting scientists and scholars, grants to cover capital expenditures for land, buildings, and non-expendable research equipment, and operating grants for the purpose of establishing centres of scientific excellence.
 - (c) Provide assistance to industry by means of disseminating scientific and technical information, encouraging selective immigration, granting tax credits to firms which establish research and development laboratories in Canada, performing special developmental work in Government laboratories at cost, and furnishing Government testing and standardization facilities for use by industry.
7. The national science program should be implemented initially by three National Science Institutes reporting to a cabinet-level Department of Science and Technology, and a Crown Corporation charged with maintaining special telecommunications facilities. Each Institute should be empowered to do the following:
- (a) Sponsor basic research in universities.
 - (b) Coordinate this sponsored research, and research in collateral scientific disciplines.
 - (c) Perform applied research on an intramural basis.
 - (d) Sponsor developmental work in existing Government laboratories and in industry.
8. The Institute for Cybernetics and Systems Science would sponsor basic research in pure mathematics, applied mathematics, mathematical statistics, computer science, and general systems theory.

It would coordinate collateral work in sociology, medical science, law, engineering, education, (including research in computer-aided-instruction), psychology, economics, demography, anthropology, and solid earth science.

The Institute would carry on intramural applied research in simulation, mathematical programming, queueing theory, decision theory, and optimization.

It would sponsor developmental work in the fields of industrial engineering, regional planning, urban renewal, national resources allocation, metropolitan transportation planning, educational technology, programme monitoring and evaluation, and computer applications such as computer-aided instruction sequences and computer-aided design programmes for use by Canadian industry.

9. The Institute for Materials Science would sponsor basic research in solid-state physics, quantum mechanics, crystallography, and spectroscopy.

It would coordinate collateral work in chemistry and electrical engineering.

It would perform applied research in ferrous metallurgy, non-ferrous metallurgy, high-vacuum technology, and allied disciplines.

The Institute would sponsor developmental work in microelectronics (especially integrated circuits and large-scale integration), lasers, nuclear fuels, and refractory materials for space technology and nuclear science.

10. The Institute for Scientific and Technical Information would sponsor basic research in bulk storage systems (for example, those based on holography), pattern recognition, automatic indexing, search strategy, and applicable computer science.

In contrast with the other Institutes, this one would be responsible for conducting operations such as recording, acquiring, classifying, translating, indexing, abstracting, and coding scientific information. In this capacity, the Institute would be responsible for monitoring activities outside of Canada as well as collating information developed in intramural and contract research, and by Canadian industry. It would store, retrieve, and disseminate information; perform research and development aimed at increasing the effectiveness of libraries, the patent office, and existing information centres; be responsible for coordinating scientific conferences, displays, and publications; and develop an interactive network for exchange of scientific and technical information among extant scientific and technical information centres.

This Institute would absorb much of the work of the Canadian Standards Association, provide a permanent secretariat for its sectional and working committees, and furnish representation for Canada at international standards conferences.

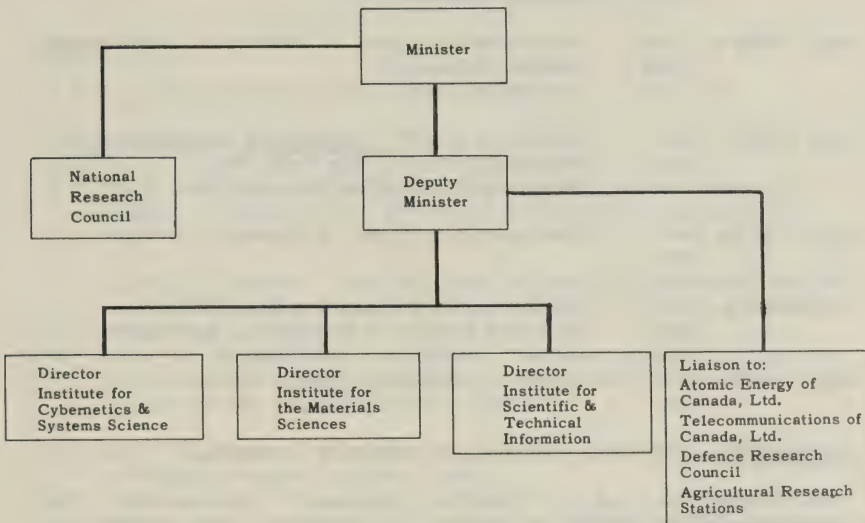
It would establish national standards for products, processes, materials, and devices so as to provide technical guidance to Government contracting officers and the Department of Consumer Affairs, coordinating existing efforts in these areas. It would evaluate scientific and technical material, and promulgate standards for routine quality control and product verification in industry.

The Institute would perform calibration of secondary standards for industry, Government agencies, and universities; and do non-routine quality testing to evaluate the characteristics of materials, devices, products and processes.

It would be responsible for publishing and cross-indexing all Canadian standards.

11. An organization to be known as Telecommunication of Canada, Limited should be established as a Crown corporation and assigned the responsibility for planning, developing and implementing a national communications network of high-speed data channels linking all Canadian population centres, especially those in the Northwest Territories and other underdeveloped regions. This network, which would likely make use of telecommunications satellites in stationary earth orbits, would be used for exchanging scientific and technical data and information, administrative information, computer programmes, education television programmes, and computer-aided-instruction sequences. The network should operate or interconnect with real-time computing facilities adequate to serve the needs of its users.
12. Organization of the Department of Science and Technology would be as follows:

Department of Science and Technology



Respectfully submitted,

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"Careers and Opportunities in Computer Science" (E.P. Dutton Co.,
1961).Research interests are in information systems design including
automatic indexing, on-line data collection and analysis, and
computer-controlled product verification.

JOHN F. HART

Head, Computer Science Department,
The University of Western Ontario.

Education:

Bachelor's in Physics, University of Toronto 1946.

Master's in Physics, University of Toronto 1948.

Doctorate in Physics, University of Toronto 1953.

Experience:

- | | |
|-----------------|---|
| 1953 to 1959 | - Assistant Research Officer, Applied Physics, N.R.C. |
| 1959 to 1960 | - Secretary, Computer Committee, Physics Dept., University of Western Ontario. |
| 1960 to present | - Head, Computer Science Department, University of Western Ontario. |

Other

N.R.C. Grant Selection Committee for Computers 1962-1965

Publications:

- J.F. Hart & G. Herzberg: "Twenty-Parameter Eigenfunctions and Energy - Values of the 2^3S States of He and He-like Ions". Physik 171, 1963.
- J.F. Hart & W. Fraser: "Near-Minimax Polynomial Approximations and Partitioning of Intervals". Comm. ACM, 7, 1964, pp. 486-489.
- W.J. Cody, W. Fraser, and J.F. Hart: "Rational Chebyshev Approximations Using Linear Equations". Numerische Mathematik, 1968, (accepted for publication late 1968).
- J.F. Hart, S. Takasu: "Systems and Computer Science". University of Toronto Press, Toronto, 1968.
- J.F. Hart et al: "Computer Approximations". SIAM Applied Math Series, John Wiley & Sons, New York, 1968.

APPENDIX 81

Brief to the
Committee on Science Policy of the
Senate of Canada

by

FACULTY OF ENGINEERING
CARLETON UNIVERSITY

April 1969

Introduction

It is evident that Canadian society is increasingly based on technology. Thanks to the automobile and jet aircraft, for instance, today's citizen enjoys the benefits of high mobility; conversely, he is often cursed with pollution, noise, and traffic congestion from these same sources. Automation serves to increase his leisure time, but also demands a continual updating of his skills.

We wish to express our concern about policy affecting the Applied Sciences. As a Faculty of Engineering, we believe that science and technology should be used to produce a more livable world as well as a high material standard of living.

Clearly the social and human problems which appear in a technological society are formidable. Solutions call for a concerted interdisciplinary effort from the physical scientists, social scientists, and engineers. It seems to us, then, that an effective science policy must have two objectives. On the one hand, it must encourage the growth of the material well-being of Canadians through scientific and technological innovation. On the other hand, it must seek to guide such developments so that science and technology are the servants of man, and not the reverse.

Desirable Policy

The ultimate concern of Canadian Science Policy should be the well-being of Canadians. Since it is through technology that scientific discovery serves the people, applied research must be a vital aspect of a Science Policy. It is not only pure scientists who discover new scientific truth; applied scientists, spurred by the objective of their research, often discover new relationships required in order to proceed to their goal. Engineering research can point to several examples in this category: information theory, numerical methods, free-radical chemistry, etc. In any case it is illogical to expend resources on basic research without carrying through with applied research and the development of technology. Technology is today one of the most important ingredients of national prosperity. Indeed, the Task Force on the Structure of Canadian Industry links capital and technological innovation together as equally essential for industrial growth.

We believe, as would Professor Arthur Porter whom you interviewed on March 20, 1968, that the people of the nation should become more scientifically and technologically literate. Such literacy surely cannot but improve and enrich the life of the Canadian people, in both human and monetary terms. Dr. S. Okita recently spoke to you pointing out the emphasis placed on technology in Japan as compared to the emphasis placed on pure sciences here in Canada. We do not think that a national science policy involving mainly pure science is a policy that can lead to involvement by the average citizen, because he cannot readily relate this science to his everyday life. A national science policy that is based upon the application of science can help people to take an interest through their ability to relate to most engineering and applied science projects. The need for technical literacy to become generalized is of the highest urgency. It is necessary for the efficient government of the country, since the voters must be able to understand national policy in order to support it. It is necessary for a high level of employment, there being fewer and fewer jobs available that do not require at least some technical competence.

In putting science to work, technology has all too often stopped short of becoming as broadly accessible as might be desired. For instance, the skills and effort required to operate a computer are not negligible to the non-technical individual. It is today possible to provide him with a telephone connection to a time-sharing machine, which he could instruct in simple words - about his income tax data for instance - and which would then complete the requested calculation returning it to him by mail together with a bill-card. This card could be inserted into a card reader connected by telephone to the bank, so that the bill would be paid automatically. This example is merely an illustration of how much smoother some tasks could be made by letting technology come right down to the people. For all the foregoing reasons, and because of the economic considerations discussed further on, it appears to us that the time is long overdue for the establishment of policies concerning applied sciences in Canada.

We believe that research in the universities can contribute significantly to technological and social advances. However, in order that the potential contribution of the universities be fully exploited, we would recommend that Canadian research personnel be encouraged to form strong viable groups according to their research interests in areas of acknowledged Canadian need. Every university today aspires to excellence over a broad spectrum in order to fulfill its obligation in all the fields of education it covers. The result is a dispersion of talent over all the universities, and a dearth of institutions having real depth in specific fields of research. Until a research group reaches a certain size, a "critical mass", its work tends to be fragmented and its output disjointed. Once the critical size is reached, however, it is capable of an output of sustained excellence and impact. We believe that Canada has more than the critical number of people in several areas and, therefore, wish to add our voice in support of the formulation of a policy that would bring these people together and provide adequate facilities to further our progress in such fields as computers, communications, transportation, northern development, urban development and natural resource development.

To make the most effective use of Canada's research potential, viable applied research institutes, closely associated with universities, should be established. Each institute should have a well defined field of interest relevant to Canadian needs. Where appropriate, each should also be associated with a particular company or industry. The source of funding for these institutes should be contractual so that the institutes do not become simply a further outgrowth of government laboratories. The initial funding may be predominantly from government grants, but the objective of each institute should be to become less and less dependent upon direct funding from this source. By way of examples we might mention the Gas Turbine Laboratory at M.I.T., the Institute of Aerospace Studies at the University of Toronto, and the newly-formed University Institute system in Germany.

Another factor which would render research effort more effective is contact between research workers in different disciplines, e.g. sociology and engineering, and between those in different sectors, e.g. government, university, and industry. We believe that industrial and government personnel should assist with the education of students and that university faculty should participate in the continuing education of people from industry and government, when required. Industrial concerns should ensure that their problems and interests are conveyed to the other two groups to provide practicality and perspective. We would like

to see structures evolve that will bring about these exchanges, and believe that a national program for the exchange of people from the various sectors could be instituted and would be beneficial. We believe that the research institute system will facilitate these aims.

There is a need for publication and dissemination of Canadian applied research results, both at the popular and at the scientific levels. Societies, or associations, exist today in many fields of scientific endeavour in Canada. These function admirably to bring together persons having similar interests. The Federal Government should continue to assist in the formation of such groups. As an example of need, we consider that a national electrical engineering association would benefit the country and, hopefully, would result in the establishment of a Canadian research journal in electrical engineering.

It has been suggested by Dr. W. G. Schneider of the National Research Council in his presentation to your committee that Canada faces an impending oversupply of Ph.D. graduates in Science and Engineering. We would like to state that these conclusions depend upon the continuation of present hiring policies and management decisions regarding the use of these highly trained persons. It is to be hoped that the greater depth of understanding that is usually linked with this advanced degree will be recognized soon by management. Employment of Engineering Ph.D. graduates by industry should result eventually in better leadership as some of these people assume executive positions.

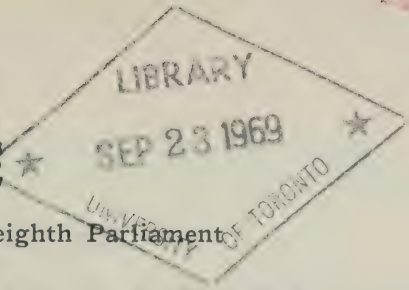
American dominance over Canada's technology has often been cited as a reason for the relative lack of interest in applied science projects in Canada. A Science Policy should encourage all companies in Canada, be they owned by Canadians or not, to carry out research and development in Canada proportionate to the volume of their business. We believe very strongly that the time has come for Canadians to realize that they must do, and are capable of doing, a large amount of original and relevant engineering and applied research, and such work should be publicised and encouraged. At the risk of stating the evident, we would draw attention to the need for thorough appreciation of research work being done abroad, so as not to duplicate identical work unnecessarily, the results of which are freely available.

An effective policy requires a body having adequate responsibility to do the planning and enforce its decisions. We believe that the Government of Canada should assume the responsibility for Science Policy, as it does for Foreign Policy and Defence Policy. Various advisory bodies can be consulted, or instituted if necessary, but the final policy decisions must rest with the Government. The Science Policy should recognize and emphasize the economic and humanistic gains that are to be made when mission-oriented objectives determine priorities. The evaluation of the expected returns per dollar invested in research can be done today on sound technical grounds (cost-benefit analysis), and should form the basis for decisions. This cost-benefit analysis must take into account social, human and economic returns as measures of effectiveness.

Finally, we of the Faculty of Engineering at Carleton University wish not only to contribute by the submission of this brief but also to participate actively in Canadian technological development.



First Session—Twenty-eighth Parliament
1968-69



THE SENATE OF CANADA

PROCEEDINGS OF THE SPECIAL COMMITTEE ON SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 48

THURSDAY, MAY 29, 1969

WITNESSES:

Dr. F. A. Forward, Consultant on Research Administration, University of British Columbia, Vancouver, British Columbia; Dr. John F. Postma, Research and Liaison Officer for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia; Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta, Edmonton, Alberta; Dr. James B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary, Calgary, Alberta; Dr. B. W. Currie, Dean, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan; Dr. A. B. Van Cleave, Dean, Faculty of Graduate Studies, Regina Campus, University of Saskatchewan, Regina, Saskatchewan; Dr. H. E. Duckworth, Vice-President (Academic), University of Manitoba, Winnipeg, Manitoba; Dr. D. R. Moir, Dean, Faculty of Science, Brandon University, Brandon, Manitoba.

APPENDICES:

No. 82—Brief submitted by Research and Liaison Office for Academic Development, Notre Dame University of Nelson, British Columbia. No. 83—Brief submitted by the University of British Columbia. No. 84—Brief submitted by the Research Board of the University of Manitoba. No. 85—Brief submitted by the University of Lethbridge. No. 86—Brief submitted by the University of Alberta. No. 87—Brief submitted by the Department of Geological Sciences, University of Saskatchewan, Regina Campus. No. 88—Brief submitted by the Faculty of Administration, University of Saskatchewan, Regina Campus. No. 89—Brief submitted by J. W. T. Spinks, President, University of Saskatchewan. No. 90—Brief submitted by the University of Calgary. No. 91—Brief submitted by the J. B. Mitchell Junior High School, Grade VIII Students, Winnipeg, Manitoba. No. 92—Brief submitted by B. W. Currie, Vice-President (Research) University of Saskatchewan, Saskatoon, Saskatchewan.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the field of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the service of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, May 29, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.00 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Bourget, Cameron, Carter, Giguère, Grosart, Haig, Kinnear, McGrand, Phillips (*Prince*), Robichaud and Yuzyk—(14).

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*)

Gilles Paquet, Director of Research (*Human Science*)

The following witnesses were heard:

Dr. F. A. Forward, Consultant on Research Administration, University of British Columbia, Vancouver, British Columbia.

Dr. John F. Postma, Research and Liaison Officer for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia.

Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta, Edmonton, Alberta.

Dr. James B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary, Calgary, Alberta.

Dr. B. W. Currie, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan.

Dr. A. B. Van Cleave, Dean, Faculty of Graduate Studies, Regina Campus, University of Saskatchewan, Regina, Saskatchewan.

Dr. H. E. Duckworth, Vice-President (Academic), University of Manitoba, Winnipeg, Manitoba.

Dr. D. R. Moir, Dean, Faculty of Science, Brandon University, Brandon, Manitoba.

(*A curriculum vitae of each witness follows these Minutes*).

The following are printed as Appendices:

No. 82—Brief submitted by Research and Liaison Office for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia.

No. 83—Brief submitted by the University of British Columbia, Vancouver, British Columbia.

No. 84—Brief submitted by the Research Board of the University of Manitoba, Winnipeg, Manitoba.

No. 85—Brief submitted by the University of Lethbridge, Lethbridge, Alberta.

No. 86—Brief submitted by the University of Alberta, Edmonton, Alberta.

No. 87—Brief submitted by the Department of Geological Sciences, University of Saskatchewan, Regina Campus, Saskatchewan.

No. 88—Brief submitted by the Faculty of Administration, University of Saskatchewan, Regina Campus, Saskatchewan.

No. 89—Brief submitted by J. W. T. Spinks, President, University of Saskatchewan, Saskatoon, Saskatchewan.

No. 90—Brief submitted by the University of Calgary, Calgary, Alberta.

No. 91—Brief submitted by the J. B. Mitchell Junior High School, Grade VIII Students, Winnipeg, Manitoba.

No. 92—Brief submitted by B. W. Currie, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan.

At 12.35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Currie, B. W. Dr. Currie is renowned for his extensive work on aurora borealis and is director of the University of Saskatchewan's Institute of Upper Atmospheric Physics. In 1958 he was in Moscow for two weeks for meetings connected with the International Geophysical Year. He has been president of the Canadian Association of Physicists, a member of the American Geophysical Union, and the American Meteorological Society. He is a fellow of the Royal Society of Canada and the Royal Meteorological Society. Professor Currie has served on numerous associate committees of the National Research Council and the Defense Research Board, in particular the Associate Committee on Geodesy and Geophysics; Associate Committee on Radio Science; Extra-mural Electronic Panel of Defence Research Board; Leader, Canadian Delegation to 1960 Assembly, International Union of Geodesy and Geophysics. Dr. Currie is a graduate of the University of Saskatchewan. He received the degree of bachelor of science (B.Sc.) in 1925 and the degree of master of science (M.Sc.) in 1927. Three years later he received the doctor of philosophy degree (Ph.D.) from McGill University. Dr. Currie joined the staff of the U of S in 1929. He was on leave from the university from 1932-34 to serve as a meteorologist in the Canadian Meteorology Service. In 1952 he became head of the physics department (a position he relinquished Sept. 1961 in order to allow him more time to devote to his increasing responsibilities.) On July 1, 1959 he was appointed Dean of the College of Graduate Studies. In June, 1962 he was awarded the Canadian Association of Physicists gold medal. The medal is awarded annually by the association for achievement in physics and Dr. Currie was the seventh person to receive the award. He has published numerous papers in his special field, the aurora borealis, as well as papers on earth currents and meteorology. He was president of the University of Saskatchewan Alumni Association for two terms, 1945-46 and 1946-47, and was president of the Faculty Club in 1958. Dr. Currie was born in Helena, Montana, and attended high school at Netherhill, Sask. He is married and has a son and two daughters. Dr. Currie was appointed dean of faculties in December, 1964. This appointment is an administrative one which may be considered to take the place of a vice-president (academic) for the Saskatoon campus. Dr. Currie was named vice-president (research) in April of 1967.

Duckworth, Henry Edmison. Born: Brandon, Manitoba, November 1, 1915—only child of the late Reverend Henry B. Duckworth, D.D. and Ann Edmison Duckworth. 1935, B.A. (University of Manitoba); 1936, B.Sc. (University of Manitoba); 1937, Teaching Certificate (University of Manitoba); 1937-38, Instructor in Mathematics, Stonewall (Manitoba) Collegiate; 1938-40, Lecturer in Physics, United College, Manitoba; 1942, Ph.D. (University of Chicago); 1942-45, Defence research work at the National Research Council; 1945-46, Assistant Professor of Physics, University of Manitoba; 1946-51, Associate Professor of Physics, Wesleyan University, Connecticut; 1951-65, Professor of Physics, McMaster University, Hamilton, Ontario; 1956-61, Chairman, Department of Physics, McMaster University, Hamilton; 1961-65, Dean of

Graduate Studies, McMaster University, Hamilton; 1963-65, Member of Board of Governors, McMaster University, Hamilton; 1965-66, Vice-President (Development), University of Manitoba; 1966, Vice-President (Academic), University of Manitoba. 1954, Elected to Fellowship in the Royal Society of Canada, Elected to Fellowship in the American Physical Society; 1955, Nuffield Travelling Fellowship; 1961, University of Manitoba Jubilee Award; 1964, Medal of the Canadian Association of Physicists; 1965, Tory Medal of the Royal Society of Canada; 1966, D.Sc. (University of Ottawa); 1966, Honourary Fellow (United College). 1956-62, Editor of the Canadian Journal of Physics; 1961-67, Member, Honourary Advisory Council, National Research Council; 1963, Leader of Canadian Delegation to General Assembly of International Union of Pure and Applied Physics, Warsaw, Poland; 1960, President, Canadian Association of Physicists; 1964, President, Section III (Science Section) of the Royal Society of Canada. Member, Defence Research Board; Member, Manitoba Research Council; Chairman, Committee on Extramural Research, Defence Research Board; Chairman, IUPAP Commission on Atomic Masses and Related Constants; Director, Manitoba Institute of Management. Publications: 1958, "Mass Spectroscopy", in the Cambridge Monographs on Physics Series, Cambridge University Press, England 206 pages. 1960, "Electricity and Magnetism", Macmillan Company of Canada (Tor.) and Holt Rinehart & Winston (New York), 424 pages. 1960, (Editor of) "Proceedings of the International Conference on Nuclidic Masses", University of Toronto Press, 539 pages. 1963, "Little Men in the Unseen World", Macmillan and Company Ltd. (London and Toronto), 149 pages. Numerous scientific articles.

Forward, Frank Arthur, B.A.Sc., P.Eng., F.I.M., F.C.I.C., M.Inst. M.M. M.C.I.M. D.Sc. Dr. Forward was born in Ottawa in 1902, attended Ottawa Model School, Lisgar Collegiate and University of Toronto where he received the degree of B.A.Sc. (Honours) in Chemical Engineering in 1924. From 1924 to 1929 he was a smelter operator and research metallurgist with Consolidated Mining and Smelting Company of Canada Ltd. at Trail, B.C. Moving to Australia in 1929 he was Assistant Smelter Superintendent, Mount Isa Mines Ltd., Mount Isa, Queensland, until 1934 when he returned to Canada, spending one year as metallurgist with B.C. Nickel Mines Ltd. He joined the University of British Columbia as Assistant Professor of Metallurgy in 1935, became Professor in 1941 and Head of the Department in 1945 a post he retained until 1964 when he was granted leave by the University to go to Ottawa to become the first director of the Science Secretariat in the Privy Council Office. In this post he was responsible for the initial organization of the Science Secretariat and the preparation of material for the Science Council Act, and the organization of Science Council staff. He retired from this post, and from his university position, in 1967. Since July 1967 he has been Consultant on Research Administration, The University of British Columbia and Consultant to Sherritt Gordon Mines Limited. In the period since 1937 he has acted as consultant to Sumitomo Company, Niihama, Japan; Algoma Ore Properties; B.C. War Metals Research Board (Technical Director); Freeport Sulphur Company, New York; Chinese National Resources Commission, Formosa; Sherritt Gordon Mines Limited; Canadian Uranium Research Foundation (Director of Research). He was the first Chairman B.C. Chapter, American Society for Metals in 1941; Vice-President Canadian Institute of Mining and Metallurgy, in 1943-44; President, B.C. Association of Professional Engineers, 1948; President, Dominion

Council of Professional Engineers, 1949; Member, Canadian Delegation to First Atoms for Peace Conference in Geneva, 1955; Member, National Research Council, 1962-64; President, Canadian Institute of Mining and Metallurgy, 1965. In 1955 he was awarded the Leonard Medal, Engineering Institute of Canada; the Inco Medal, Canadian Institute of Mining and Metallurgy; and the McCharles Prize, University of Toronto; in 1959 the Mining World Achievement Award; 1960 the John Scott Award by the City of Philadelphia; in 1962 the Gold Medal of the Institution of Mining and Metallurgy and the R.S. Jane Memorial Lecture Award by the Chemical Institute of Canada; 1963 the Engineering Alumni Medal, University of Toronto; in 1965 the James Douglas Gold Medal, A.I.M.E. and the honorary D.Sc. degree by the University of British Columbia; 1966 the Institute of Metals Platinum Medal and in 1967 the American Academy of Achievement Golden Plate Award. Dr. Forward is a Fellow of the Chemical Institute of Canada and of the Institution of Metallurgists (Gt.Br.), a member of the Canadian Institute of Mining and Metallurgy, American Institute of Mining, Metallurgical and Petroleum Engineer, Australasian Institute of Mining and Metallurgy, Institution of Mining and Metallurgy (Gt.Br.), Institute of Metals (Gt.Br.), Gesellschaft Deutscher Metallhütten u. Bergleute, Canadian Research Management Association. Author of some 30 technical papers including section on "Hydrometallurgy" in Encyclopedia Britannica, 1961 ed. Inventor of pressure leaching process for nickel ores and processes for recovering tungsten, uranium, lead, zinc, tin, resulting in considerable number of patents. Married, 1927, to Dorothy Christina Ransom, they have four sons.

Hyne, Dr. James Bissett. Dr. James Bissett Hyne, chemist, was born in Dundee, Scotland, Nov. 23, 1929, the son of William and Winnifred (Bissett) Hyne. Dr. Hyne came from Scotland to Ottawa, Ont. in 1954. Dr. Hyne married Ada Leah Jacobson of Boston, Mass. U.S.A. on Sept. 3, 1958. He received his public school education in Dundee, Scotland and high school at Morgan Academy, Dundee, Scotland. He attended St. Andrews University and obtained his B.Sc. (Honors) in 1951; in 1954 his Ph.D. at the same university; Fellowship in Chemical, Institute of Canada (F.C.I.C.) 1964. He is a member of Sigma Xi fraternity. From 1954-56 he was post doctorate fellow chemist with N.R.C. (National Research Council), Ottawa, Ont.; 1956-59, instructor of chemistry, Yale University, New Haven, Conn., U.S.A. 1959-60, assistant professor (chemistry), Dartmouth College, Hanover, N.H., U.S.A. In 1960 Dr. Hyne joined the Faculty at the University of Alberta (now University of Calgary) as an associate professor of chemistry, and administrative officer (dept. of chemistry). In 1963 he was appointed head of dept. of chemistry. In 1964 he became full professor of chemistry, and 1966 to present he is Professor of Chemistry and Dean of Faculty of graduate studies. He is also research director, Alberta Sulphur Research Ltd., 1964 to present, consultant chemist, and a small rancher. Dr. Hyne served from 1947-54 in the U.K. Territorial Army, and joined as private and was discharged with the rank of Company Sergeant Major. From 1954-58 he was in the Cameron Highlanders of Ottawa, Ont. with the rank of second lieutenant. Active in business and professional organizations he is a fellow of the Chemical Institute of Canada and was secretary and treasurer of the organic division, 1963-65; member, American Chemical Society; Faraday Society; Canadian Association Graduate Schools, Interim Faculty Representative Board of Governors, University of

Calgary, 1968. Dr. Hyne has published fifty scientific papers to date. He was the recipient of a Medal in Geology in 1948 at St. Andrews University; 1951-54 University Research Scholarship at the same University; 1954-56 Post Doctoral Fellowship, Ottawa with the N.R.C., and in 1967 he received the Canadian Centennial Medal.

McCalla, Arthur, G., B.Sc., M.Sc., Ph.D., F.R.S.C., F.A.I.C. Born, St. Catharines, Ontario, in 1906. Received the B.Sc., (Agriculture) in 1929 and the M.Sc. in 1931 from the University of Alberta, and the Ph.D. in 1933 from the University of California (Berkeley). From 1933 to 1939 was Research Assistant in the Department of Field Crops, University of Alberta. The year 1939-40 was spent on post-doctoral research at the Institute of Physical Chemistry, University of Uppsala, Sweden, working on the physical-chemical properties of wheat gluten. Appointed Sessional Lecturer at the University of Alberta for 1940-41; Professor of Field Crops in 1941; Professor and Head, Department of Plant Science 1944-51; Dean, Faculty of Agriculture, 1951-59 and Dean, Faculty of Graduate Studies, 1957-present. Fellow of the Royal Society of Canada and the Agricultural Institute of Canada. Member of the National Research Council of Canada 1950-56, and member of various N.R.C. committees for many years. Member of the Canadian Commonwealth Scholarship and Fellowship Committee since its inception in 1959. Research interests concerned principally with the study of the physical-chemical properties of plant proteins with special emphasis on wheat proteins.

Moir, D. R. Attained degrees: B. Sc. (Hons.) U of Manitoba; M.Sc., U of Manitoba; Ph.D., U of Manitoba. Research Interests: Plant Morphology, Taxonomy, Atmospheric Pollens. Research Experience: Extensive floristic research ranging from New Mexico to the subarctic zone of Canada; research grants from N.S.F., A.A.A.S., Arctic Institute of N.A. Position: Dean, Faculty of Science Brandon University.

Postma John F. Born October 14, 1926. The Hague, The Netherlands, in which country he received his elementary and secondary schooling as well as most of his undergraduate level university education. Came to Canada in 1951, did three years of graduate level work in theology at St. Augustine's College in Toronto, moved to Nelson, B.C. in 1954 to assume the post of Superintendent of Buildings and Grounds at Notre Dame University. Became a Canadian citizen in 1956. Earned a Master's degree in Philosophy from the University of Ottawa and a Master's degree in Political Science and Public Administration from Carleton University (1960-61; 1965-67), including graduate level work in the areas of sociology and law (administrative and constitutional). Versant in five languages. Over a decade of experience in university teaching in the departments of language, philosophy and education at Notre Dame University. Ten years administrative experience at this University in the positions of Superintendent of Buildings and Grounds. Bursar and Dean of Men (until 1965). In the Fall of 1967, appointed as Research and Liaison Officer for Academic Development. This has included work for this University in the area of administrative and academic structuring and planning, as well as work on 'briefs' submitted by Notre Dame to a variety of Commissions and Special Committees at the national and provincial level. In this capacity I have also represented the University at

various meetings of an official or public nature. Has extensive experience in youth work and a 3-year experience in newspaper work as editor-in-chief and business manager of a weekly newspaper for the Southern Interior of British Columbia. Hobbies actively pursued include music, drawing and painting, snow-skiing, waterskiing, fishing, tennis and hiking.

Van Cleave, Allan Bishop. Born: Medicine Hat, Alberta, August 19, 1910. Married: Dorothy Elenora Yeo, Regina, August 16, 1934. Children: Galen M. (1939), M. Elaine (1940), Dalton C. (1942), Carol M. (1945). Education: Estuary, Saskatchewan, 1918-1924, Elementary School; Empress, Alberta, 1924-1927, High School; University of Saskatchewan, 1927-1931, B.Sc. (Honours Chemistry); University of Saskatchewan, 1931-1933, M.Sc. (Physical Chemistry); McGill University, 1933-1935, Ph.D. (Physical Chemistry); Cambridge University, 1935-1937, Ph.D. (Surface Chemistry). Scholarships: N.R.C. Bursary, 1932-1933; N.R.C. Studentship, 1933-1934 (Resigned); 1851 Exhibition Scholar, 1935-1937. Honours: Centennial Award, National Science Teachers Association, North East Section, Toronto, 1967; Centennial Medal, 1967; Chemical Education Award, Chemical Institute of Canada, Vancouver, 1968. Experience: Laboratory Instructor, McGill University, 1933-1935; Instructor, University of Saskatchewan, 1937-1938; Assistant Professor, University of Saskatchewan, 1938-1946; Associate Professor, University of Saskatchewan, 1946-1952; Professor, University of Saskatchewan, 1952-1962; Research Associate, A.E.C.L., Chalk River, Ontario, April-Sept. 1955; Research Associate, Cominco, Trail, B.C., April-Sept. 1957; Chairman, Division of Natural Sciences, University of Saskatchewan, Regina Campus, 1962-1969; Director, School of Graduate Studies, University of Saskatchewan, Regina Campus, 1965-1969; Dean, Faculty of Graduate Studies, University of Saskatchewan, Regina Campus, 1969-. Research Interests: Area: Physical Chemistry—Chemical Engineering. Sub area: Surface Chemistry—Analytical Chemistry—Mass Transfer. Specialty: Beneficiation of low grade uranium ores—flotation characteristics of pure minerals—X-ray fluorescence analysis. General aim of current research is to accumulate sufficient information on the surface characteristics of minerals to predict successful procedures for separation by flotation. Professional Society Membership: Chemical Institute of Canada, Fellow, 1940-; Faraday Society, Member, 1939-; Royal Society of Canada, Fellow, 1963-; Nuclear Science Association of Canada, Member, 1957-. Offices Held in National and Provincial Organizations: President, University of Saskatchewan Alumni Association, 1948-1950; Councillor B, Chemical Institute of Canada, 1948-1951; Chairman, Chemical Education Division, C.I.C., 1952-1953, 1965-1966; Member, Canadian Services Colleges Advisory Board, 1960-1965; Chairman, Canadian Services Colleges Advisory Board, 1964-1965; Member, Defence Research Board, 1966-; Member, Saskatchewan Research Council, 1968-. Publications: 1. Silicon Hydride, Monatomic, or Triatomic Hydrogen, A. B. Van Cleave and A. C. Grubb, J. Phys. Chem. XXXVI, 2817-2868, 1932. 2. Active Hydrogen, A. C. Grubb, A. B. Van Cleave, J. Chem. Physics, 3, 139-145. 1935. 3. The Molecular Diameter of Deuterium as Determined by Viscosity Measurements, A. B. Van Cleave and O. Maass, Can. J. Research, 12: 57-62. 1935. 4. The Thermal Conductivity of Deuterium, A. B. Van Cleave and O. Maass, Can. J. Research, 12: 372-376. 1935. 5. The Variation of the Viscosity of Gases with Temperature over a Large Temperature Range, A. B. Van Cleave and

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THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, May 29, 1969

The Special Committee on Science Policy met this day at 10.00 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we are meeting the west this morning, the other region which wants to separate, but I am sure that the representatives from the universities that we have this morning still want to participate in the national science effort. We are very pleased to have them with us.

Since we have eight representatives from universities we will proceed in two shifts and we will hear first the statement from Dr. Forward of the University of British Columbia who, as you know, was the first director of the Science Secretariat when it was created in Ottawa.

Dr. F. A. Forward (*University of British Columbia*): Thank you, Mr. Chairman and honourable senators: I am very pleased to have the opportunity to come and talk about a topic that has been very close to my interest for a great number of years. I have the feeling that the first time I talked about this was in 1940, when I wrote a paper which I had been thinking about for some time.

I bring the regrets of Dean Armstrong who had hoped to have been here today but who is engaged in the convocation ceremonies at the university.

The brief from the University of British Columbia was prepared in consultation with the UBC's president's research policy committee, of which I am chairman. The draft was examined by the department heads in the science faculty and presented to the committee of academic deans, and also to a number of the department heads in engineering.

This, therefore, cannot be said to be the consensus at the University of British Columbia. I do not suppose there is such a

thing, but it seemed to be a practical way to try to get some view of what a number of people who are interested in this think. Anyone interested in science policy in the university had the opportunity to contribute to it.

There are really two components in the UBC brief. The first comprises excerpts from the briefs that were presented to the Macdonald study group. The second, then, is a statement of structure. This is derived from a brief that was prepared at the end of last year as a result of a study that I had made for some other purposes.

I will recount just very briefly the items that are contained in the list—it is not a complete list—of the things that we suggested to the Macdonald Commission:

The first was that the federal government should reaffirm its position taken at the federal-provincial conference in October, 1966, that the federal government intends to remain in the business of supporting research. We believe that this should be re-affirmed and strengthened.

The second point is that the federal funds should be allocated for capital purposes, rather than as at the present time where none of the research funds that come from federal sources are really available for this purpose.

The Chairman: Always related to research?

Dr. Forward: Related to research, yes; I am not talking about education in general. It is funds for research. As a matter of fact there is some suggestion on the part of one or two of the people in the University of British Columbia who are concerned with this that perhaps we have almost adequate funds for operating. The thing that is going to hold up the advancement of development of research in the universities is space to do the work in.

The third point is that we feel that there should be an extension of the federal advisory committee structure, that there should be more committees on which university people

can serve and participate, not only in the National Research Council and medical research and so on, but in many of the other agencies and departments of government.

We feel that the "centre" concept should be expanded. We have talked about centres of excellence, but this refers generally to the method of handling and operating centres in universities. We feel that these centres might be associated with the government agencies or departments.

The fifth point is that we feel that the mutual arrangements for accommodation of research personnel could be expanded, that government people might work in university laboratories and, of course, university personnel could work in government laboratories.

In No. 6 we state that we feel that there is a place for mission-oriented research.

In No. 7 we state that there is a growing need for "institutional" type research grants, rather than just project grants to individuals.

In No. 8 we state that we are very much concerned that there should be a uniform procedure in respect of research contracts in universities. There was some talk yesterday about the desirability or otherwise of contracts. We feel rather strongly that the contract is a useful form; it need not be very formal. Sometimes it is used, but the trouble now is that every government department has its own ideas of what the contract ought to be like. This keeps the university lawyers, the accounting people, the department heads, and myself in research administration, busy trying to figure out what each of them wants. Surely this can be simplified and put on an ordinary basis.

We believe too that there should be a direct policy on "out-of-pocket indirect costs" in the universities for research. We suggested too in the brief the establishment of councils, particularly for fields not now supported. We suggested a number of councils, perhaps more than Dr. Macdonald has recommended in his report, but this is a matter of detail. We feel that there is a place for these councils that is rather different from what we see at present.

Then, the final point of those that we submitted to the Macdonald group is that related to the need for library and other services for people in the arts faculty.

I would like to say something about the structure for providing advice on science policy in Canada, the second point in the brief. This is again something that I have been interested in for a very long time. I had

the opportunity last autumn to make a study of the structure that exists in other countries. There has been some mention here of the structure in France. I had some correspondence with people who are familiar with the Russian structure. I have also had access, as everybody has, to the material of France, Japan, Britain and the United States, and some private correspondence with people in the United States.

It turns out that when you look at these there are really five components in the structure for forming science policy. One is the top level decision-making group at the ministerial level. This finds its counterparts in nearly every other country. In France you have the Committee of Ministers. In Russia there is the Council of Ministers. In the United States, of course, there is the President and the Cabinet. In Japan there is a somewhat similar group.

The second group that appears substantially everywhere is what you might call the scientific advisers to government. These are people who are part of the government in a way. They are independent people appointed for their own personal qualities. The counterpart of that in France is the so-called Advisory Committee for Scientific and Technical Research, sometimes referred to as "the Twelve Wise Men". In the United States the President's Science Advisory Committee, PSAC, is the nearest counterpart to this. We do not have exactly the same thing in Britain.

The third group that appears uniformly in every country is the so-called "In-house" Government Research Advisory Group. In the United States this is the Federal Council for Science and Technology; in Japan, the Science and Technology Agency. There are others, not quite exactly comparable, in France and Russia.

The fourth component in the structure for science policy in every country is some method of getting advice from the scientific community. In this way people throughout the country who are interested in science have an opportunity to have their views transmitted. They also know they are being transmitted to this decision-making group at the top.

In Japan this is the Science Council of Japan, which is a unique organization, as I am sure some of you will realize. In the United States this is done by the National Academy of Sciences through their Committee on Science and Public Policy, COSPUO, and by congressional committees.

There are some less formal arrangements in France and Russia but there is really not anything very positive about them. I think it is the "old boy" Network in Britain, rather than anything positive.

Finally, there is in every country a small body of full time professionals in government service who assemble information from these groups, and present these views to the decision-making body.

Looking at this, it occurred to us that we might see how we compare in Canada. We find, of course, that we do have some of these components here. One is the Privy Council Committee. This is the committee of ministers, the political decision-making group.

The Chairman: The cabinet committee.

Dr. Forward: The Privy Council Committee on Scientific and Industrial Research, yes. This is the committee of ministers. It is at that level, at least, where the political decisions are taken.

The Chairman: It is where they are supposed to be taken.

Dr. Forward: No comment. We also have in Canada the third group. I will leave the second one for the moment.

We have another inter-departmental committee on science and technology. In effect there is an inter-departmental panel of deputy ministers, or senior officials of science-based agencies in government which exists now. It has been commented on by the Glasco Commission. It does not meet very often, and it does not do very much. I do not know whether that is the counterpart of the Federal Council on Science and Technology in The United States, and I do not know how successful they are in getting deputy ministers together in the United States.

The Chairman: We heard a little bit on this during our last trip.

Dr. Forward: Ours has not met very often. The other one that we have here is the Science Council of Canada. I will say a word about that now. This really is the counterpart of the National Academy of Sciences in the United States. The fifth one that we have, which is the government group, is the Science Secretariat.

The one that is missing—although I sense in the presentations that have been made, and the discussion that has taken place before this committee in the past months and to

some extent yesterday, we are getting very close to it—is the counterpart of the President's Science Advisory Committee or "the Twelve Wise Men" in France. We do not have a group of people who are simply there as individuals, without any axe to grind, except their own personal convictions about scientific things. That I think we should have. So, in the brief from the university we have suggested the formation of a science advisory committee.

If I may take just a moment to read it, we have said:

...this would be a new committee comprising twelve to fifteen top level scientists, technologists, sociologists, humanists chosen from outside government who would serve in a voluntary, but confidential, capacity. The committee should have access to privileged information...

In this respect it would be different from the Science Council.

...should meet at least monthly, and should be prepared to advise on proposals arising from government departments, Science Council, university granting groups and other sources in the community.

This would be a completely objective group of people; not all scientists. This is the suggestion which we have made for the formation of a new committee.

The Chairman: Would it be more or less similar to what they have in the United States?

Dr. Forward: It is the counterpart of the PSAC, yes. These people are like Caesar's wife; they are highly regarded in the community and they are grinding no axes.

We have some views on the formation and function of the Privy Council Committee, and of the relationship of the National Research Council to that committee. We have some other strong views about the composition of the Science Council of Canada. We have some rather strong views about the accounting for public funds, about the character of university research as between pure and applied science, about indirect costs, and about this matter of university-industry collaboration.

I do not want to take more time now, Mr. Chairman, but if anybody wants to ask any questions in this area I will do my best to express my own views.

The Chairman: Thank you very much. We could spend, I am sure, a week asking questions about all the issues you have raised but, as you know, we do not have that amount of time, so we will try to concentrate on major issues.

We will hear now from Doctor John Postma, who represents Notre Dame University of Nelson.

Dr. John F. Postma (Notre Dame University of Nelson): Thank you, Mr. Chairman, and honourable senators. I will not read our brief, which is short. You have a copy of it and I am sure you have read it.

Matters of time and other considerations forced us to limit this to going over some of the basic distinctions, roles and identification processes that we felt are so necessary in order to achieve some kind of a defensible rationale with regard to all these problems. We feel that somewhere along the line there have to be decisions on the interpretation of terms that we keep on using here from time to time.

It is going to be inevitable on the part of the committee that the proposals you make, and the eventual policies that will come as a result of them, will reflect in one way or another the traces of one interpretation or another regarding some of these distinctions. Or, I suppose we can expect them to reflect in a model sort of a way an indiscriminate mixing up of interpretations and concepts, with all the practical consequences that flow.

A case has been made about the university role in relation to political and social problems of the kind that the Senate Committee is concerning itself with to the effect that certainly one important contribution that the university should make is perhaps not to be immediately, or in the first place, concerned in bringing up practical proposals or conclusions.

The university should in the first place, but not exclusively, concern itself with the area of premises, because in the final analysis we feel that your final conclusions are going to be political decisions in the broadest sense. This is inevitable. This is the preoccupation of politicians and people in the government, but that is certainly the first contribution that universities should make to this process of decision-making. If we are concerning ourselves with the area of premises, then I think we have to concern ourselves with a great deal more precision about a number of dis-

tinctions, interpretations of roles and identities, and so on that we at times make and then forget about for one reason or another.

This makes the whole thing rather insecure and uncertain. I suppose there will always be insecurity and uncertainty with regard to these problems that are in the practical area.

For instance, as a simple example—we really have not become serious, for instance, about a definition of research, which is what the whole thing is about. I think a number of very interesting and important consequences could flow from one or another interpretation of the word “research”.

This is somewhat disconcerting to me, because, as I say, I feel that the university contribution in the first instance has to be in the area of premises. The validity of premises to a large extent depends upon the interpretation and use of terms.

So, our brief to a large extent consists of a plea for more precision, for the making, and the maintenance in a consequent manner, of distinctions that are going to be very helpful, or not so helpful if we forget about them.

Research is in relation to study—the element of newness in research, the public and the social aspects of research, and so forth. It is not just a matter of semantics, even though we can be tempted to relegate this for the sake of convenience to that area. It is easy to say: “Well, that is just so much semantics.” I just do not operate this way and I find it rather disconcerting when we lack precision in this sort of thing. The distinction between science and technology has been referred to many times during the last three days. Many of us could probably arrive at some kind of a consensus as to an interpretation of the difference between these areas but, again, the fact of the matter is that after we make these distinctions we then proceed to forget about them in tackling the practical problems. I think this hurts the practical process.

We talk about university work globally and generally, without maintaining the distinctions that have to be made between undergraduate level work and graduate level work, and between universities.

The second recommendation of the Association of Graduate Schools of Canada, if you recall, made an interesting point inasmuch as it recommended that universities themselves in the first instance should take time out to identify themselves in roles as individual or particular institutions, or as area institutions

in relation to the total university effort. Very little of this is done. We tend to deal with these subjects in generalities, and I think this hurts the practical problem-solving process.

If we are going to deal with relationships between universities, governments, industry, professions, all of whom have interests in and engage in research of one kind or another, then until such time as you have an idea that you somehow or other try to maintain about the role of the university you cannot really make a great deal of sense in talking about the relationships between the university and some other institution.

We have to go back to some of the more basic considerations with regard to professional responsibilities, industrial responsibilities, governmental responsibilities, and university responsibilities at the graduate and undergraduate levels.

Our brief to a large extent was a plea for more clarity and decision on that score. This kind of interest goes back to my background in philosophy. On the other hand, I have a real bent towards worrying about the mechanics of this because I have a background in political science and public administration. Inevitably, when we come to deal with questions like this, we are going to have to fall back on one interpretation or another of federalism, and of social and political philosophy of one kind or another. As I say, we do not really use a great deal of precision sometimes, but we do end up with one or another interpretation that we, perhaps with very little defence, decide upon in the process.

For instance, there are federal and provincial responsibilities. I would be very interested in seeing some work done by the committee with regard to the federal responsibility in education. I think sooner or later this issue has to be tackled in a formal way, and we cannot keep on running away from it, or postponing it, because the BNA Act happens to have been written in one way or another. As you know, the earlier decisions of the Judicial Committee of the Privy Council had recourse to what was called the dimension doctrine, or the aspect doctrine, of constitutional interpretations. I think we should raise the question again as to how valid these decisions were. If they could be valid today we could then end up with the possibility of viewing the federal, provincial, and local levels of responsibility as supplementary to

one another, instead of going from the generic down to the specific on the particular with regard to an area like education.

It is to me a strongly defended opinion that we are always preparing what is, in my mind, an impossible separation of powers approaching federalism. This is about as unrealistic as the separation of disciplines approach in "multiversity", for much the same or similar reasons. I also think that if we are going to talk about grants we have to keep on maintaining distinctions about the kinds of grants, incentive payments, conditional grants, supplementary assistance and so on. The debate loses a great deal of its force and its coherence to the extent that we forget about this.

That was just a reference to our brief which concerned itself with the demands that we should legitimately make of ourselves as academic people if we are going to make a contribution as academic people.

We did not go in to the matter of the structure and economics of this, except in the last two or three paragraphs. The suggestion was made the day before yesterday—and I think a very interesting debate came about as a result of it—as to some kind of structure that would incorporate governmental agencies, people in the professions, people in industry and people in the universities.

Depending upon one's interpretation of federalism, the idea appeals to me. I think it is necessary to think of some kind of a body that has this pluralistic representation on the part of all those engaging in research. Then again I think we would have to face the possibility of having to duplicate this to some extent at the provincial level. I think you will also then run into difficulty between businesses. Some of the most important ones of them are provincially incorporated, and others are foreign-owned and so on, yet much research originates with business.

We would have to try and keep all these difficulties in mind. If the Senate Committee is concerning itself with federal policy, in my scheme of things these policies should be of a generic nature, seen against the whole background of the federal picture. There are difficulties in some interpretations, so we need general federal policies in the area of education generally and in the area of research—whatever that means.

Apart from going into any details to the extent this might be possible, they should concern themselves with some long term or

general propositions, such as long term budgeting requirements on the part of industry, government, or university and so on.

The degrees of communication in the inventory requirements struck me as a very useful area yesterday when we got to talk about that. Federal policies would have to deal with those general aspects of research to some extent, but to what extent is not too clear to me.

Perhaps certain types of support could be conditional upon coordination. The structures could be set up, certainly at the federal level, and perhaps they should be duplicated at the provincial level to incorporate people in the government, people in industry, people in the professions, and people in the universities. Perhaps the possibility of the ear-marking of tax transfers should be considered as part of that general policy area.

At the same time, apart from all these things, if we could discuss again in the general session this afternoon the mechanics of the subject and concrete proposals it would be of benefit.

I am aware of the fact that in the last analysis the final decisions will be political decisions in the broadest sense. The government, even in its research policies, is going to have to take into account things that are perhaps academic. It is going to have to overlook things such as the cultural problems, the area development problems, the small university problems and so on. We are fully aware, of course, that somewhere along the line the final recommendations will have to involve a large element of accommodation to the practical requirements of the case.

I think that is about all I have to say.

The Chairman: It will be a long time before we reach decisions. Thank you very much for this plea for logic and some kind of co-operative federalism.

Now we will hear from Doctor McCalla, who is professor of plant biochemistry and Dean of the Faculty of Graduate Studies at the University of Alberta. He is accompanied today by Dr. Hunka, Professor of Educational Psychology and Director of Educational Research, and Dr. Robinson, Professor and Chairman of the Department of Chemical and Petroleum Engineering of the same university.

Dr. A. G. McCalla (Dean, Faculty of Graduate Studies, University of Alberta): Mr. Chairman and honourable senators, the brief of the University of Alberta has been in your

hands for some time. We want only to underline a few of the most important items, but we consider the brief as a condensed summary of the opinions at our university. Let me stress the following:

1. The principal thesis underlying our brief is that individual scientific creativity in Canada must be encouraged as an essential element of the total Canadian research effort. A formal national science policy, which puts major emphasis on a few mission-oriented projects, is essentially an attempt by government, or committee, to channelize creativity of its scientists towards the realization of pre-conceived national goals. True creativity does not easily conform to the transient political goals of a nation, and excessive emphasis on channelizing this creativity may destroy or drive it from Canada. A science policy must therefore provide for the encouragement of this creativity by providing for more than mission-oriented research.

2. I call special attention to this document, which is called "Traces"—Technology in Retrospect and Critical Events in Science. A study of this should provide ample answers to such suggestions as: "Expenditures on basic research are not in the best interests of at least the economic development of any country", as stated by Senator Lang, quoting another work, in an early hearing of this committee. The document also shows the futility of attempting to separate the sequence of basic and mission-oriented research. We commend this document to you for study if you have not already seen it.

3. We agree that the whole series of research steps, basic, applied, developmental to innovation and production, which has not been mentioned much really in these hearings, must be provided for. You can have all of these steps adequately financed and innovation result, but, unless there is the necessary risk capital to put the innovation into production, the whole sequence has failed to benefit Canada and that is what we believe that a Canadian science policy should do.

4. Any national science policy must recognize that the universities have a unique role in research and this is the education and training of the researchers of the future. We must have the means to do this adequately.

Now I would like to make a few comments on the Macdonald report, which was not available when this brief was prepared.

1. This report deals inadequately with graduate student support. It recommends ten

per cent of graduate students on national scholarships, but none on research grants. At Alberta we have 13 per cent of our more than 1,800 full-time graduate students on national scholarships, and 20 per cent appointed on research grants. The province of Alberta and the University of Alberta provide support for nearly all the remainder or two-thirds of the total. But we cannot afford to lose any of the one-third from federal sources. We think it should be higher if all disciplines are supported. The University of Alberta believes this matter needs further consideration and, furthermore, believes that the Canadian Association of Graduate Schools should be one of the groups to take part in any further consideration.

2. We are flexible on the number and form of granting agencies, providing that the following objectives are achieved: (a) Support for all disciplines; (b) decisions re individual awards and grants are made by those who are knowledgeable in the disciplines; (c) there be a person, whether a minister or not, who speaks for Canadian science, including the humanities, and has direct access to the Cabinet; and (d) a single advisory body be set up to oversee the general operation of granting bodies and I take it that this is much the same as the UBC advisory committee.

3. We oppose recommendations No. 48 and No. 55 of the Macdonald report, that all rates of remuneration be based on the university's policies and that there be no ceilings. This can only work to the advantage of the wealthier universities. We would like to see reasonable ceilings, but also the right of a university to pay less if they wish and can get satisfactory holders for the awards or jobs. This works very well in our own graduate assistant programs.

The Canada Council has commented on the Macdonald report, and we wish to deal with three of these comments:

1. No. 7, on page 4 of the Canada Council commentary: Canada Council does not agree that it should be relieved of its responsibility for the humanities and social sciences, and that a humanities and social science research council be formed.

We believe that the Canada Council does not serve the universities as efficiently in its fields as NRC and MRC do in theirs. It is almost impossible to compare the pre-doctoral fellowship program with grants to symphony orchestras, and we think that one body, with

the best will in the world, will not handle both jobs well.

We therefore support McGill University's submission in its support for recommendation No. 5 of the Macdonald report.

2. We question the statement in No. 14, page 12, that:

...the Council's experience has shown that the balanced arrangement...

And this arrangement is a lay decision-making body and two large panels.

...is by far the best device yet found to ensure due appreciation of the needs of a highly-specialized public as well as continued acceptance by Parliament of the measure of autonomy with which the agency is entrusted.

3. No. 31, page 26, says the Macdonald report infers that the Council's partnership is with the universities rather than with the research scholars and Canada Council obviously disagrees. One of our serious complaints about Canada Council policies is that they award research leaves, fellowships and travel grants without requiring university approval. We strongly support recommendation No. 37 of the Macdonald report that, without exception, all federal funding applications of any kind be approved by the university and be channeled exclusively through the universities.

Now, Mr. Chairman, in the discussion—I think it had better wait until then—Dr. Hunka would like to make some comments about a new computer.

The Chairman: This is a new addition to the republic of science, and I do not think that the citizens of that republic will accept this veto power of the universities.

Dr. McCalla: May I make one comment on this, Mr. Chairman?

The Chairman: Yes, please.

Dr. McCalla: There was a reference to veto power. It is not veto power we are talking about at all. What it is is that the universities know. Somebody yesterday made the remark that it was quite possible under Canada Council leave fellowships for a man to be taken off just about at the beginning of the term without his dean even knowing about it. What we are asking for is that some responsible person in the university, and this is what the Macdonald committee said, should at least

sign the document. We are not talking about veto power.

Dr. Forward: Mr. Chairman, may I support that one hundred per cent.

The Chairman: I think we have to hear now from Dr. Hyne, from the University of Calgary.

Dr. James B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary: Mr. Chairman and honourable senators, one of the difficulties in speaking to a brief that was prepared several months ago is that in the intervening period many very important bodies and individuals have commented on the whole question of the science policy for Canada.

What I would like to do this morning in the course of some ten minutes is to go through the various points that were raised in the brief of the University of Calgary and try to relate them to the comments that have been made in the period intervening between its preparation and today.

I feel that I shall be referring most frequently to one or more of the following documents, or sets of documents: The Macdonald committee report; the Canada Council commentary thereon; the Science Council Report No. 4, which some of you may recall was the one which really raised the mission-oriented question into a place of prominence; and, of course, the various reports and comments that have been made and have emanated from the hearings of this Senate committee.

The first thing I would like to turn to, sir, is the question of the mechanism of the provision of support from government to universities, from federal government to the universities.

May I make a plea that we not move in the direction of channeling all federal government support through the provincial government? I am sure that members of the Senate, the university community, and provincial government authorities are well aware of the fact that virtually every university in Canada is already very highly dependent on provincial government support.

If the federal government agencies are to channel their support, even indirectly, through provincial government control, then universities will be in the position where 100% of their support will be controlled directly or indirectly, by provincial governments. This I feel would be bad. I think one

of the basic reasons that the federal government is in the business of supporting universities at all is because a sizeable proportion of university activity is national, not provincial. Therefore, the national body should have the dominancy in how its money is to be used.

On the question of how the federal government should adjudicate the disbursement of its support to universities I am afraid that I am a little more hesitant than Professor Forward was in his statement about the generation of more councils.

I do not like holding the chairman to statements made about him in the press...

The Chairman: I was probably misquoted.

Dr. Hyne: This is a cutting from yesterday's paper. I just draw your attention to the headline, which I think is very true: "Canadian Science lacks Coordination". I think one of the quickest ways to make coordination even more difficult is to generate more bodies that have to be coordinated.

While I am not saying that there is not room for a few other organizations to assist the federal government in the disbursement of its research funds, I would again plead for caution here, that if we have too many councils then we will be going backwards in the matter of coordination, not forwards.

On the matter of the Macdonald committee's recommendations regarding the future role of the existing agencies I would again plead that we not throw the baby out with the bath water.

I agree with Dean McCalla in his statements, and those of his colleagues from our sister campus in Edmonton, that all is not well with the federal granting agencies. I can remember, as I am sure many others in this room can, the days, not so very long ago, when the situation vis-à-vis the relationships between the universities and the federal agencies were far worse than they are today. I would rather try and improve the relationships with the bodies that we do have than run the risk of finding ourselves operating with a new organization that we do not know anything about.

I feel that the matter of intercommunication between the federal agencies is a crucial one that has to be clarified in any future definition of Canadian science policy. In this regard I would be favourably disposed towards supporting the inter-council committee that was recommended by the Macdonald

committee. This would serve a very useful purpose. Notwithstanding the comments made in the Canada Council commentary on the Macdonald brief that they are in fact supporting now all these areas that used to fall between the stools, this is not so. Mind you, they try very hard, but every year there is a new inter-disciplinary area that emerges and the Canada Council cannot keep up with it all the time. Archaeology is a magnificent example of not knowing whether to apply to Wellington Street or Montreal Road—usually what happens is that they finish up in the Ottawa River. So I feel that some kind of formal inter-council committee is certainly needed.

May I now turn to the question of the use of the federal support in order to implement science policy, the use of federal support dollars for the training of the scientists of tomorrow, who are the graduate students of today.

I was shocked to read one of the Macdonald recommendations that said that the federal government and its agencies should plan to support ten per cent of the full time graduate student body in Canada.

In fairness to the Macdonald committee I must also add that this was immediately after the recommendation that provinces be allowed to add into their allowable cost computations for federal government matching support provincial money that was used for graduate scholarships. This, of course, means channeling more money through the provincial governments, but ten per cent...well, the figure for 1968-69 is 37 per cent. There were approximately 20,000 full time graduate students in Canada in 1968-69. Canada Council had 2,500—these are all rounded off figures—full time in pre-doctoral fellowships. The National Research Council, through its fellowship and bursary program, had 3,500.

Now, this does not take into account any of the money that was used from professorial grants to support graduate students. You have already got 6,000 of them out of 20,000 supported and ten per cent would be a reduction of more than 100 per cent. This is just incomprehensible to me.

The Chairman: You might have an explanation this afternoon.

Senator Bourget: They were counting on inflation I suppose.

The Chairman: On deflation.

Senator Bourget: Well, whatever it is.

Dr. Hyne: I endorse Professor Forward's recommendations for some kind of clarification of the contract position wholeheartedly. We handle this at some length in the Calgary brief. More than one government agency at the moment is using the contract method of supporting research in universities simply because the federal government does not authorize that agency to give grants in aid.

I do not think I should name any names, but they are there and they are a headache because the money is used and applied for in almost exactly the same way as a grant, but it comes under all the restrictions of contract work.

I turn now to the question of overhead, which has always been a sore point with universities. This was first raised by the Bladen commission two years ago and is still with us. There is no doubt in my mind and, I would hope, in any university administrator's mind, that contracts must be fully covered as far as overhead is concerned. That is the essence of a contract. In the corporate world nobody would even consider tendering on a contract unless he knew that he could make a profit. That means that he builds in all his overheads and all his real costs. I think the universities should do the same thing.

As far as overhead on grants is concerned, this is a little trickier. I certainly think that the grants should have some built in dollars for universities. These dollars might be channeled through what the NRC now uses, the president's NRC grant, rather than actually putting it in as a straight overhead cost.

There is no doubt in our minds at the University of Calgary that the federal government has got to interest itself far more directly in the establishment of the repositories of knowledge in this country, namely the libraries.

Some of us who deal directly with the agencies through the graduate schools were shocked and horrified last year at the suggestion from one of the agencies that the rather minimal support that they were then giving to libraries at universities in Canada might be terminated. This is one of the biggest costs and the biggest hold-ups in development of any kind, be it science or social science, in Canadian universities.

My colleague from Notre Dame University of Nelson raised the question of definitions. I know that I should have a better understanding of the English language, but the words "mission-oriented" still defy me as to their

precise meaning. I know that it is supposed to lie somewhere between pure research and applied research, but if we are going to start trotting out phrases like "mission-oriented research", then somebody had better define them in a great hurry, otherwise the usual game-playing will start. One group will say: "Mission-oriented" means this, and, therefore, we are right", and the other group will say that "mission-oriented" means something else. I think it is a good concept. There is an area between pure and applied which can properly be followed as a research discipline. "Mission-oriented" is as good a phrase as any, but let us have it defined a little more closely.

My last point, sir, is a political hot potato, but I do not think that there is any better place to raise a political hot potato than in a political hearing.

The Chairman: And here we have the long view.

Dr. Hyne: That is the question of centres of regional excellence. I think it is fairly obvious, whether one is talking about massive libraries, or massive computers, or massive pieces of scientific equipment, that with 20 million and an expectation of 40 million within the next half century Canada simply cannot put pieces of equipment each costing \$10 million in every major urban centre in Canada.

This inevitably means centres of regional excellence. It also unfortunately means that some group of people are going to have to have the guts to turn around to somebody and say, "We are awfully sorry but we can only afford one, and you have lost out". Now, maybe the next time around, or something else, you will win. But you cannot say: "There is \$10 million. We could spend it all on one piece of equipment but politically that would be suicide, so we have got to spend four times \$2½ million". With \$2½ million nobody gets anything.

This country is so large, and its climate, activities, and culture are different enough from the Atlantic to the Pacific, that we do have at least some guidelines.

There is no sense whatsoever—and I apologize to the marine biologists and the petroleum engineers for using them as examples right now—for in establishing marine biology in Saskatoon, or Edmonton, or Winnipeg. Marine biology is marine biology; there are obvious places for marine biology.

Likewise I do not see any real reason why anyone should set up petroleum engineering

research institutes in Ontario or Quebec. There are places in this country that have established resources that are more directly related to these activities. These are only indications of how one can at least begin to look at regional excellence, but it is a political hot potato.

I am disturbed that the Macdonald committee did not spend more time on this one, because this is a way in which the government of this country can really save money.

I am sure that the senators are getting a little tired of hearing university people appeal for more and more money. Unfortunately the barrel is not bottomless and we have got to stop somewhere. Here is one way where I think this country can save money.

My final question, sir—and I thank you for allowing me to go a little over time—is: Is it really sensible to think of one policy that encompasses such a wide diversity of activities as science, social science and the humanities? I do not necessarily endorse C. P. Snow's two cultures, but I am sure the humanists will not buy some of the policy concepts that are applicable to the sciences; vice versa it will also be true. Perhaps we should not feel too disappointed if we have to settle for two policies, or three policies.

Thank you very much.

The Chairman: Thank you very much. We are running a little bit behind in our schedule; we will have to proceed a little more quickly and have our second shift, so I will call on Doctor Currie, Doctor Van Cleave, Doctor Duckworth and Doctor Moir.

We will begin this second phase by hearing Doctor Currie, who is Dean of Graduate Studies, and Professor of Physics from the University of Saskatchewan.

Dr. B. W. Currie, Dean, Vice-President (Research) University of Saskatchewan: Thank you, Mr. Chairman.

The Chairman: Before the beginning of the space program?

Dr. Currie: No, I was involved in this one. Actually I am speaking on two briefs here. One was prepared by our president, Dr. Spinks, who has had of course a long experience in matters scientific and the policies related to them, and the other is a brief which I should perhaps describe as a personal brief. It is very difficult, of course, in things like this to avoid being repetitious. I am really going to pick out key points in the brief.

First of all I might say that I think I agree completely with Professor Hyne and I think our group in Saskatchewan does, about his comments on the Macdonald report.

We had a meeting yesterday morning at which this was discussed in some detail and I think that we could agree almost wholeheartedly with him. I would stand to be corrected by Dr. Katz, who is also present. Our feeling at that time was that this should be treated as a working paper, a position paper.

You always need this sort of thing in order to expedite discussions. As long as it is taken in this concept then it is a very valuable document, but if you take it that these recommendations are God speaking, then you are into troubles.

First of all, concerning Dr. Spinks' brief, it is entitled *The Role of the Universities in Research Towards a Systems Approach*. There is a considerable amount of material which, of course, emphasizes the importance of the university both in the training of people for research or scholarly work in the country. In other words the universities in Canada become one of the big industries, which he refers to as the knowledge industry. His plea is really for a systematic approach which will produce the best results, with the minimum expenditure of dollars.

He quotes various documents related to this and I am just reading odd headings here: Thus greatly increased federal research support, both operational and capital, is required. In addition the method of giving this support to ensure that it is used in the best interests, that is in the best interests of the recipient institution and the province within which the institution is established, needs a thorough re-examination.

There is a section on federal-provincial liaison: While the federal government has exhibited a concern for science and technology for the last century, it is only within the last two or three decades that the provinces have shown a corresponding interest.

He refers to the provincial research councils and the federal government in the establishment of a science council. He concludes that the role of the provincial research effort in the overall national research effort is still far from clear. To date no obvious steps have been taken to integrate or coordinate provincial research plans to the federal government's grants assigned to science and technology.

In a country the size of Canada more, not less, coordination of effort is clearly indicated. If Canada is to find its proper place in the world dominated by highly sophisticated technologies collective autonomy should be the slogan.

Then he goes on: It is strongly recommended that the federal government take immediate steps to strengthen its science policy-making machinery, at the same time assuming a leadership role in promoting a more effective coordination of the scientific efforts of the provinces.

Another point which he emphasizes is planning with respect to research in the execution of those plans to help in the establishment of a medical research council or a health science research council, reporting directly to a minister of the Crown.

I think this has been taken care of. It is strongly recommended that the federal government take immediate steps to strengthen its policy-making machinery with respect to the arts, social sciences and humanities and at the same time assume a leadership role in promoting a more effective coordination of activities in the humanities and cultural activities of the provinces.

Then there is a long section on the coordination of the inter-provincial research efforts. He introduces the point that you need coordination within each province. We are, of course, in Saskatchewan a great believer in the uni concept; we are trying to borrow the California or New York procedure of having one university with two and possibly eventually three campuses.

There is a very real attempt to coordinate or collaborate so that we make the most effective uses of our resources for the benefit of the province. Many of the things which are of benefit to the province of course eventually become of benefit to Canada as a whole.

This inter-provincial collaboration, or coordination, is progressing in a rather slow way at the present time between the three prairie provinces, where I think the deputy ministers and the principals and presidents of the universities meet.

Again, this is talking about such matters as Professor Hyne brought up, centres of excellence to avoid duplication, to try and avoid duplication of research efforts and, of course, the unnecessary expenditure of dollars.

At the same time we endeavour to make the most effective use of the effective, or potential potential that exists within the universities.

I do not think I need to take your time up with some of the documentation. This, of course, with a number of universities can conceivably be done by a university grants committee such as they have in Ontario and I think in Manitoba, do they not, Dr. Duckworth, and Alberta. We still think we are better off working as a unit, one university, and discussing these matters with our treasury officers and the minister of the treasury and so on.

The Chairman: You prefer centralization rather than coordination.

Dr. Currie: Well, it is a combination of coordination and centralization, but I think the various campuses do better in this way, in settling our own problems rather than having a sort of external committee go out and do this.

I think that some of the universities do work with these external committees for the distribution of funds.

The Chairman: It at least reduces the demand for university presidents; they are becoming a scarce commodity now.

Dr. A. B. Van Cleave, Dean, Faculty of Graduate Studies, Regina Campus, University of Saskatchewan: On the contrary, Mr. Chairman, we have to have three instead of one.

Dr. Currie: Dr. Van Cleave may not agree with me; he is from our Regina campus.

The section on inter-provincial coordination of higher educational activities has only just started at the inter-provincial level through agencies such as the Association of the Universities of the Atlantic Provinces and this one which we have on the prairies which I have mentioned.

In this respect Canada lags far behind such countries as the United States of America, where there has been for a long time now a very powerful federal agency for the support of higher education.

Educational liaison at a rather more general level takes place in Canada through the recently formed conference of ministers of education.

Then he makes the point that these various methods of coordination of university activities on the provincial-national scale are the first stirrings of what might be called the systems approach to higher education.

There is a final sentence in this paragraph: Strong federal leadership is imperative. Then

he goes on to some sections on centres of excellence, which I do not think I need mention; federal fiscal transfers in relation to higher education, which he ends up with the statement that the establishment of a powerful federal office on higher education which might be expected to assume a leadership role is long overdue.

There is a lot of supporting material and so on, sir, but I do not think we need to take up time with that.

The Chairman: The brief of course will be part of our proceedings.

Dr. Currie: Yes. My own brief originates perhaps from a very long experience in Saskatchewan and some knowledge of what has taken place within the province. I start off with the current discussions on a science policy for Canada failing to recognize the responsibilities and potential capabilities of our universities for research and consultative services related to the needs of the community or the province in which each is located.

They are limited generally to broad aspects of an overall policy designed to meet the economic and cultural needs of Canada as a whole.

Then I go on further: Universities located in many parts of Canada are the most immediate sources for know-how to investigate problems peculiar to their respective locations and to provide consultative services to small industry.

I think, sir, that you find this more so in what we might call, I hesitate to say, the deprived provinces but you find this in the prairie provinces and I think you may also find it in the maritime provinces.

I emphasize that any integration that exists between their activities and those of neighbouring universities depends largely on casual arrangements, rather on a well-recognized policy for Canada.

I have a number of examples here which point out that the usual practice of recognizing the small problem within your community, which is in fact one of the services which universities must provide, can in fact lead to notable advances which are of benefit to Canada in particular.

I mention in particular the work of Dr. C. J. Mackenzie which, of course, we well know. He recognized in this area that there was a need to do research work on concrete, which deteriorates under the influence of alkali. There was work initiated on improved types

of concrete by Dr. Mackenzie and Dr. Thorwaldson in chemistry. This was one of the notable things that was initiated and which played an extremely important role as far as economic development in western Canada and in the world as a whole is concerned.

We also had the work of W. P. Thomson, who was in biology. He came to the university at the time when rust research was extremely important. There was the problem sitting on his doorstep. He went to work on it and many of eminent crop breeders in Canada in the past three decades are people who worked with him.

Of course we got these rust resistant varieties and some idea of what to do, which was of enormous benefit to Canada.

I go on and say something more about this. You can have collaboration; this is the same point I am emphasizing. I think our dollars are limited. I am very much of the opinion that we must have close collaboration between universities, provincial laboratories and dominion laboratories. Some of them are situated on university campuses.

We have had one or two examples in Saskatchewan of this close collaboration. In the very early days of the soil survey we had our own university group, we had a provincial group and we had a dominion group. They had to work in the same offices, because this space was very limited, so we never knew who worked for the province, who worked for the federal government and who worked for us. Through this has developed an extremely valuable knowledge, not only of basic soil science, but of the effective utilization of fertilizers.

If you read the western papers you will probably discover that our crop yields in the last few years have been much greater than the precipitation would suggest. This has been due really to the effective use of fertilizers.

Here was a multi-collaboration between university, province and federal people. I am not prepared to argue that this increase in grain production is good; certainly we have too much at present.

The Chairman: I was going to say that it is not necessarily a blessing.

Dr. Currie: No, I would hesitate to say that. I can quote a number of other points, but I make out eventually that there are well recognized series of steps as you start from (a) recognition of a local problem with some

economic implications; (b) initiation of research both fundamental and mission-oriented with respect to it; and (c) the application of the results of the second, (b), by industry.

Step (a) is generally obvious to the university researcher. If he is on the bit, as it were, he is in this community, he has a service to the community, he generally sees these problems.

First of all he has to have financial support to get on and there is a stage of fundamental research, some innovation. The next step, of course, is further development, innovation and so on, which seems to be divorced completely from the universities.

Yet, you can see in some of these provinces like Saskatchewan and so on the possibilities, because small firms and so on come to you for advice; they have got no other place to go. If you had some machinery by which you could do what I would call development work to help with this innovation, financial support, there are many cases where you could build up a small industry which could eventually blossom into quite an important unit, not only in the provincial economy but in the dominion, as far as Canada as a whole is concerned.

This is something, of course, which simply does not exist at this time.

One may argue that all problems in particular parts of Canada have been recognized and are receiving adequate attention from universities and various government organizations.

I just point out that there is little support for such an argument. We have a lot of potash 2,000, 3,000 feet below the surface. There are many problems here which, because they are at hand, we should be operating on. A great portion of our province borders on the north and there is an unlimited number of problems that need investigation.

Since we are bordering on these and, of course, our friends in Alberta and Manitoba also do, I think that we have an interest there and should be participating more actively. Again, this involves dollars; it is partly because it involves more than fundamental research, it does involve government agencies and so on and you get into this, which is very expensive.

Now, I have not mentioned the upper atmosphere; we did develop upper atmosphere. I think I should just get in this plug

for a very, very good reason in Saskatchewan: The auroral zone, which is a disturbed region of the atmosphere and the ionosphere, came the farthest south at that time to the university of Saskatchewan. We were closest to it and we had the right geographical position to work on it.

The university was on the north side of the city too, very fortunately, so we did not need to worry about working over the top of the city lights. I think that Dr. Porter and maybe even Dr. MacKenzie mentioned this.

I think I have taken up enough of your time; thank you, sir.

The Chairman: Thank you very much.

As you know, this is the first time we have heard that potash may raise a research problem. It has been known here in Ottawa for several years as a political hot potato, so that if you could solve the political problem through your research it would be welcome.

Now we have Dr. Duckworth, who is Vice-president, Academic, of the University of Manitoba.

Dr. H. E. Duckworth, (Vice-President (Academic), University of Manitoba: Mr. Chairman, Honourable senators, gentlemen: First I give the regrets of our president, Dr. Sanderson, who is at the University of British Columbia today, to quote from the invitation, attending the annual convocation and installation of the new president.

Mr. Chairman, you and other members of the committee have had from the University of Manitoba a brief some time ago which was prepared by the so-called research board. I might say that the members of this board include nine persons elected by the graduate faculty; they include the deans of all the faculties engaged in graduate work in research as well as the president, the dean of graduate studies and the vice-president (academic).

Senator Cameron: Is there no student representation?

Dr. Duckworth: Not yet, sir, no.

Now, in this brief, from which I shall quote some portions, we say at the start that we recognize that many points have been made to the Senate Committee. With a large number of these we concur, but they have been made several times to you and it seemed unnecessary to make them another time.

In our brief instead we concentrated on five points which we think had not received much

attention, or perhaps had not been mentioned at all.

The first of these related to the granting policy which would maintain a balance between the federal support for basic and mission-oriented university research. In that connection I would like to read briefly from the brief.

Following a description of the present arrangement, in which by and large the council support basic research and a variety of federal and provincial departments support mission-oriented research, the brief goes on to say:

A possible alternative, that of assigning to a single granting agency the task of supporting both uncommitted and committed research, is a dangerous one. For example, with the present emphasis on mission-oriented research, one might find this consideration beginning to colour all grants. Thus, the nation might lose the high quality of fundamental research which it now possesses, and which is essential to underpin most of applied activity.

If the present arrangement should continue (as this brief urges)...

And, incidentally, as the Macdonald report suggests.

...the ratio of federal support for basic to mission-oriented research in the universities could be rather accurately established by means of the budget. This would avoid the danger of mixing the two considerations—to the unintended, but possible, detriment of one or the other.

The second point relates to collaboration between universities and government agencies. This was a point which Dr. Currie touched on. This is an area in which our university has had long experience, successful experience and we have strong views on the value of such collaboration.

Perhaps I could read a portion of the section from the brief:

There could and should be much more collaboration between universities and government agencies than at present exists, especially in the scientific and technical fields.

Such collaboration virtually requires the location of government laboratories on or near university campuses, as is now the case for many laboratories of the Canada

Department of Agriculture, Fisheries, Forestry, etcetera. This move towards a rational decentralization, in which laboratory sites are selected on the basis of natural regional interests as well as specialized competence in the universities concerned, has a long way to go. Furthermore, it is simply the prerequisite for the subsequent development of cooperative arrangements.

The actual cooperative arrangements may take a variety of forms including:

(a) the inclusion of government scientists in the graduate work of the university with the rights and responsibilities appertaining thereto;

(b) the establishment of integrated laboratories in which specialized equipment and information are either shared or acquired as a result of joint planning;

I should say that Dr. Currie's example of the early soil collaboration of Saskatchewan is a case in point. I could give a couple of examples which we are currently trying to promote.

(c) the participation of government scientists in certain major university studies dealing with problems of national concern.

The third point has to do with the view taken of graduate studies. We say here graduate studies should be regarded as versatile training.

I will quote briefly from the brief in that connection. There is a rather long section in which we develop the point that the training is in fact versatile training, but then go on to say:

If the versatility of graduate study is properly emphasized, and graduating students are encouraged to exercise their competence without restriction to their fields, the graduate training in Canadian universities could contribute more substantially than now to our national aims and aspirations. In addition, the threatened surplus of students in certain areas of study would evaporate.

The fourth point, which I shall simply mention by title and not elaborate upon, because it has been touched on somewhat this morning, is the need for a greatly expanded network for scientific information.

The final point, which again I think I will just mention by title, is the support of univ-

ersity research in the humanities and social sciences.

That, sir, then, is the summary of items in the brief. Perhaps I could take a minute to comment on some matters in the Macdonald report.

These, however, are my own comments; they are my view of the attitude the university would take, but you never can tell in a university.

The Chairman: Nor in a government.

Dr. Duckworth: This has not been agreed to by the Senate, say, of the university or by the research board. First, in connection with the proposal to separate the NRC laboratories from the NRC granting function, I personally am reluctant to see the present very satisfactory arrangement discarded unless we are sure we have something that is just as good in its place.

Two, it is suggested in the Macdonald report that graduate students would be supported primarily from the university. Two speakers this morning have already touched on this, perhaps three, with the understanding that the funds will come first through the university and be shared by the province and the federal government.

We can make a strong case, we believe, for federal support of all graduate students, because after graduation these students move through the country where suitable employment offers itself. This would apply as well to Saskatchewan as to some other provinces; there are not opportunities for employment commensurate with the number of graduate students who are receiving training. We are using provincial funds to train students in advanced techniques to the advantage of other parts of the country, the nation as a whole.

Rather than reducing the support of graduate students, one should be urging that it increase because of this very fundamental consideration.

Thirdly, the Macdonald report suggests that something called a research agreement might replace both grants and contracts. I am really not persuaded that this presents any advantage over the present system.

Fourthly, it is suggested that granting agencies should pay the indirect as well as the direct costs. I am sure you will never find a university representative to oppose that, so I heartily endorse that suggestion.

Fifthly, I am getting now to small points. The suggestion is that the general university grant from the National Research Council, colloquially referred to as the president's grant, should be removed. In our case this grant, a small grant which amounts to about \$100,000.00 per year, does no end of good things. I am not sure that \$100,000.00 from our point of view could be spent in a better way.

The Chairman: Does it involve more security for the dispenser of the funds?

Dr. Duckworth: It means that the president, sir, is able to recognize certain emergency situations in the university which perhaps did not exist at the time applications were made for grants, or in some cases were not recognized by the granting agency. He has this local knowledge and the money serves many useful purposes.

Finally, I would just say in a blanket way that I agree with the other points made by Dean McCalla in connection with the Macdonald report.

Thank you, sir.

The Chairman: Thank you. Finally we will hear Dr. Van Cleave, Dean of Graduate Studies, University of Saskatchewan, Regina Campus.

Dr. Van Cleave: Thank you, Mr. Chairman. Honourable senators, ladies and gentlemen: I would just like to emphasize a few things that really have not been brought up in the president's brief, or that mentioned by Dr. Currie.

There were some submissions from Regina campus which are more or less individual ones. What I have to say is very much an individual point of view.

For many years now I have been quite concerned about the supply of scientists and engineers in Canada. I tend to look at this rather further back than the support of research.

Professor Forward will well remember that I once appeared before him when he was with the Science Secretariat with the suggestion that we were going to have a shortage of scientists and engineers in the future in Canada unless we did something about the training of science teachers at all levels of education.

I think that this is very true; many Canadian universities are now being criticized, of course, for the number of foreign graduate

students that you find. Why do we find them there? Because we are simply not producing enough of our own in Canada. Why are we not doing that? I maintain it is because we do not have the well-qualified science teachers who are interesting these students in science at quite low levels of education, even in the public schools and in the high schools.

Some years ago I became involved in an attempt to introduce new science curricula into the high schools of Saskatchewan. At that time we looked at the programs of the National Science Foundation of the United States. We became extremely envious over the way that they were able to do things there.

I always feel and, Mr. Chairman, you may rule me out of order, but you did not rule my colleague from Nelson out of order on this—

The Chairman: We are having a very broad discussion.

Dr. Van Cleave: I feel that we are hiding behind the British North America Act in respect to education being a provincial matter. When in fact it may have seemed so a hundred years ago, it is a very out-dated point of view to take now when our teachers and professors are so mobile that they move from one province to another.

I just do not feel that we can afford to not say that the federal government should be very interested in education at all levels, not just in the support of research.

I was challenged at that time to prove that there was a severe shortage of well trained science teachers in Canada. I think we did prove that; I can state without any fear of being contradicted now, as a result of a survey that was done, that not more than at the very outside 25 per cent of those people who teach science and mathematics in our high schools are in my estimation anywhere near properly trained in the subjects that they teach.

I feel that we need more support as is given by the National Science Foundation of the United States, to organize teacher institutes within universities. You may not call this research, but I think it is certainly feeding research to update these people, make them more competent so that they will in turn generate interest in the students that come to university.

This I feel, Mr. Chairman, would be a problem that is neglected by all the other briefs. You will find that it will come up in a

brief that is being presented by the Chemical Institute of Canada next week; I had only this opportunity to speak to that.

I certainly agree with some of the other remarks that were made this morning, especially that with regard to the Canada Council. I am in the position of a Dean of Graduate Studies in a new university trying to get research in graduate studies underway. The contrast between the support that the scientist can get and the social scientists and the humanists can get is terrific, of course.

I feel that Canada Council is failing. Even though they are improving, I would agree, they are failing to give the support necessary to develop strong graduate schools in their areas in Canada.

The Chairman: Is it due to a weakness of the Canada Council itself, or to the lack of funds?

Dr. Van Cleave: I think it is both, Mr. Chairman. Their point of view is, they maintain this quite strongly, that they would not support graduate students at the Master's level.

The National Research Council has always supported graduate students at the Master's level. This has certainly been one of the major factors by which they have been able to develop strong science departments in nearly all universities.

I would submit that it is one of the reasons that we are failing to develop strong graduate schools in the humanities and social sciences, because they are not supporting students from the beginning of their graduate careers.

The Chairman: Of course, they can support that kind of activity under their act, but is it not true that they reached that conclusion because of lack of funds, rather than because they did not feel that they should do it?

Dr. Van Cleave: That may well be, but if that is the case they should have more funds.

I would also make a plea, which has been previously made this morning, that when we are having federal support for research and graduate studies and so on in Canadian universities, the support should come more directly to the university and not through the provincial government.

We have a provincial government that does not go for these 50 cent dollars.

The Chairman: Yes, but I understand that there is generally an election campaign going

on in your province, so there may be some changes there.

Thank you very much.

I understand that Dr. Moir does not want to participate in the discussion at this stage.

Dr. D. R. Moir, (Dean, Faculty of Science, Brandon University): That is true.

The Chairman: Thank you very much. We have now about three quarters of an hour, because we will have to adjourn at 12.30. The Senate is sitting at 2.00 o'clock today, so we will be able to meet at our plenary session here this afternoon at 3.00 o'clock and have some time for lunch.

I presume that we will want to adjourn at 12.30, so we have three quarters of an hour for discussion.

Dr. Postma: Mr. Chairman, I would like in connection with the remarks of the last speaker to perhaps correct a misinterpretation.

Let me just state for the record that all my creative constitutional thinking is not limited to factual comparative work. It not only ignores the BNA Act almost in toto, but also all past occurrences of federalism. I want to make sure that I was not misinterpreted there as putting in a plug.

The plea has been made yesterday and the day before yesterday. I thought we should put in a plug today for the many connections that exist between graduate work and undergraduate work, even from the point of view of very specialized research, whether it be scientific in the pure sense, or technological in the applied sense.

I am very concerned, as I am sure all of us in universities today are, about fast occurring developments. I think perhaps it might be worth the committee's while to give some thought to the possibility of federal support for the graduate schools. This is provided that the opportunities will be there for them to stick to what I consider to be their specialty. This in my mind, I think I have got this satisfactorily resolved, should concern itself with what I call educational learning. This is fundamentally interdisciplinary and coherent especially, not only because of its obvious educational values, but also because of its connections with the worthwhileness of any graduate research that will come in its wake at later stages.

I am sure that we all know that research today cannot be channeled into narrow separated disciplinary avenues. It has to be very

broad and discipline problem-oriented. There is no better preparation for that kind of specialized and perhaps even technological scientist than his training at the graduate level. It does not matter whether this training takes place under university, government, or industrial sponsorship in the first place, with assistance from the other quarters.

I think that our scientists, even our applied scientist and our applied research man of the future, even of the present, has to have even in his undergraduate level work that very broad approach along inter-disciplinary lines.

I think it is important to keep in mind the role of the undergraduate level university work. We should also take into consideration the fact that many of the really first class scientific contributions of the past had very little more than a pencil and a note pad to help them. We tend to think necessarily in terms of very technologically advanced gadgetry when it comes to scientific or technological contributions, the really creative work in scientific contributions.

The Chairman: I wonder, Doctor, if you could not wait until this afternoon to expand on these topics for the plenary session, because I know that this morning some of the members of the committee would like to ask some questions to the delegations from the west.

This afternoon we will have a more informal arrangement.

Senator Cameron? Being so closely associated with universities, in Alberta at least.

Senator Cameron: Mr. Chairman, it has been a very heart-warming experience to have the opportunity of associating with former colleagues and even present colleagues so intimately this morning. Obviously in the short time we have we must be concerned with some of the major principles which will assist the committee in formulating a national science policy.

I must say that we are indebted to Dr. Forward and his colleagues in UBC for being the first organization to present a structural possibility in the schematic form. That appears on page 15 of their submission.

The Chairman: I had the impression that it was Ottawa revisited.

Senator Cameron: I was going to say this is probably as a result of his three years in Ottawa that he knows his way around here.

However, I was encouraged to find that my colleague, Dr. McCalla of Alberta, said that this happened to be pretty much along the lines of their own thinking. It is a useful outline, even if the committee does not accept it all in detail. It is beginning to put down in structural form some of the main issues that are exercising the minds of this committee.

Dr. Forward, you referred to the need for providing federal funds for capital purposes for research; I wonder did you have any formula in mind for this? This suggestion has been made before but no one has suggested a formula as to how this might be done, as to what percentage or how the funds might be channeled and who would disburse them.

Dr. Forward: No, I have not any particular formula to suggest. Our feeling has been that if the principle were adopted this might be possible. Then there would be the opportunity to sit down and look at the proportion that might be expected. Obviously the total amount is not going to be very great. The universities and the federal granting agencies between them would have to sit down and work out just what sort of proportion would be going for this capital expenditure on university building.

The Chairman: Would it be a program of itself or connected with assistance to research?

Dr. Forward: I think it has to be connected with assistance to research.

The Chairman: Because, as you know, in the past these capital grants programs set up by the federal government have not been too successful, in the sense that provinces and even universities insist that this money be available more or less on a per capita basis across the country. You do not necessarily have the maximum results from your money in terms of encouraging research.

Dr. Forward: We suggest, Mr. Chairman, in the brief that the formula that was adopted by the Canada Council in its original form might serve.

The Chairman: It was at that time, if you remember, distributed according to population.

Dr. Forward: On a matching basis with the universities.

Senator Carter: Would you include buildings as well as equipment in a capital grant?

Dr. Forward: Yes; equipment is now available, but this is particularly towards what we euphemistically term facilities.

Senator Cameron: Does this suggest that there is need for some new machinery between the universities and the federal government to discover what the needs are and what should be allocated? Some machinery that does not exist now, or do you think that the existing machinery or machinery which may be set up under this proposal would meet the need?

Dr. Forward: Most of us are in favour of this idea, that there would be a national research board or a committee above the councils that would help in this allocation. It is there that the universities would be involved and there would be more advice.

The Chairman: Would it be more or less along the lines of the National Science Foundation in the United States?

Dr. Forward: No, this board that we had conceived was...

The Chairman: Oh, this other one, like PSAC?

Dr. Forward: No, there is still this other one we do not have yet. This board which would be referred to as correlating or coordinating, which would actually distribute among the several councils the amount of money that is going to the universities. It would perhaps take from those councils to the Treasury Board their requirements.

The Chairman: You are going then in that concept of that committee or board much further than the Macdonald study?

Dr. Forward: Probably so, yes. The determination of the percentage that would go to capital and to operating would certainly have to be determined by the council, the board, the university and government officials involved with one another. I do not see that as being the purpose of this PSAC committee; they are concerned with scientific aspects and contents of the programs.

Senator Cameron: Reference has been made several times today to the advantages of the joint federal-provincial or federal-university cooperation in the establishment of laboratories and the use of research personnel. Reference was made by Saskatchewan and Alberta to this.

I know from first hand experience that the soil service personnel, the plant methodology personnel were used in this multi-purpose function. They had a research responsibility while being employed by the federal government but they worked with the university people. They even taught in the university classes.

I have often felt that this was a very valuable approach and I am surprised that more of it is not done.

Would it be your feeling, and I am suggesting this to Dr. McCalla and to you, Dr. Forward, that there is need of a more formal representation, that this kind of program be given more emphasis in terms of getting more effective use for the research dollar we are spending?

Dr. McCalla: Well, I do not know about the formula; there are limitations to this. For example, the University of Alberta located at Edmonton was interested in the possible establishment of federal laboratories, Department of Agriculture laboratories which were related to agriculture in Alberta.

I remember very distinctly the directors of one of the divisions saying the only justification for putting an economic entomological laboratory, for example, in an area was to solve the economic problems of this area. These problems so far as agriculture is concerned are not at Edmonton, but at Lethbridge. So the laboratory was established at Lethbridge. Now we have an informal working arrangement with Lethbridge, particularly in relation to irrigation, whereby we can send our students down there. We use their personnel as assistant directors of research projects.

In our department of mechanical engineering we have the same kind of arrangement with the Suffield station of the Defence Research Board. They have certain facilities that we do not have.

On the other hand, right now there is under construction the forestry laboratory which is located on university land about two miles from the main campus. There will be varying interrelations between the people. Many of these people have been stationed at Calgary.

There has not been an entomology department as such in Calgary. These people will go back and forth between Calgary and Edmonton for a long time and they are going to work in very close cooperation. I do not think we need a really formal relationship; this will

vary. For example, it is a very nice thing for both the university of Saskatchewan and Dalhousie University to have NRC labs on their campuses. We would have been delighted to have had the prairie regional lab at the University of Saskatchewan, but we have not got it.

I think many of the arrangements can be informal or, as at Dalhousie, rather formal arrangements between the Atlantic region and the prairies.

Senator Cameron: Is there not an implication here that if we are to recognize the limitation of the public purse and following that to agree that if we are to make the most effective use of the resources we have, we have got to make the decision on centres of excellence? This has come up time and again but no one has submitted to the committee yet the criteria by which these centres of excellence are determined, where they shall be and what they shall do.

This seems to involve some pretty fundamental thinking as far as a national program is concerned and certainly very fundamental thinking as far as the universities themselves are concerned.

Dr. Forward: In our presentation we did mention centres. We did at one time use the word satellites, but people did not like this. We thought there might be, as in the case of water research, a national laboratory, that at three or four places across the country there would be a university group associated with that national laboratory. Instead of this group getting its money through the National Research Council for the area, or in some other way, they would be supported and really be the responsibility of this national laboratory.

Of course, something of this has happened at Burlington; that is the beginning of this kind of operation, in effect a national laboratory, but there must be not only Burlington but other places across the country where people are going to work in water research. I would think it would be associated with them.

The same thing could be done in communications; the same thing could be done in water pollution; but not every university is going to have a satellite or a centre in every area, as has been said so often. This was the kind of concept that we had in mind, that it would be a relatively formal association with government departments.

Dr. McCalla: Mr. Chairman, as one of the small group which made representations to the National Research Council on negotiated development grants I have been quite disappointed in the way this program has worked out. It was the anticipation of the group that made that recommendation that this is exactly the sort of thing that they would do.

One of the first disillusionments in this was that the first three negotiated development grants were all for materials research. They were all as a result of requests that had been made by universities before the program was ever set up.

Many of us have felt that while the negotiated development grants do involve university commitments later, this is a stimulation under which with today's costs and escalating costs many universities are going to have to stand back and take a look and say, can we afford to extend the negotiated development if that means that we have to take an extra million operating grant on our hands when the support is over?

I think that the discussion of the possible much closer liaison with continuing support in areas of vital interest to the federal research program is a more realistic point of view perhaps at individual standards of excellence than are the negotiated grants in some respects.

Dr. Currie: I think that the use of the word excellence, of course, has to be in parentheses. You can have too much excellence, you see. You might develop an area here so that we would have the most excellent people in the world, but we would not know what to do with them and they would not be of much benefit to Canada. You want excellence, of course, but I think we are concerned with strategic development important to the region.

Of course, many of the government laboratories were established for strategic reasons. I am not at all certain that there must be a broader concept of these. When all is said and done, when the National Research Council puts a laboratory on your campus it is an autonomous organization that works with the National Research Council. The director reports to the president of the National Research Council. You can have situations where there is no particular collaboration between provincial research councils, universities, and so on.

You do get this sort of casual collaboration, it is true. For example, the university may

have no authority whatever, or not even be consulted about the appointment of a director and often the director carries or promotes the nature of the research.

I think we followed a model that you have at Manitoba. This gives here on these laboratories some confidence, the possibility of having a relationship to the graduate faculty which can and in fact does make it possible in Saskatchewan for them to take students into their laboratories and have the benefits of this association of bright young minds.

The university, on the other hand, gets the advantages of equipment and know-how which may not exist within the university.

I am all for this sort of collaboration, but I hesitate to label it always as excellence. I think we have lived too long with excellence here in Canada.

What are the words you had for it, Dr. Katz? Expediency? No.

Dr. Katz: Irrelevance.

Dr. Currie: We have got to get relevance tied in with this. We hope that it is excellent, but you must have relevance to your community or local situation across Canada as a whole.

Senator Cameron: That is what the students are saying today. Does this very argument that you are putting forth not suggest that maybe there has been too much autonomy in some of these agencies? If we are to look at this from a national viewpoint maybe we cannot afford to leave it to one of these autonomous agencies at the National Research Council? I would be the last to cast any aspersions on it, because it has done a magnificent job, but in taking a national viewpoint do you not think that the placing of the laboratories, the kind of laboratories and the kind of plants must be considered by this national science organization, whatever it may be?

Dr. Currie: Yes, strategic establishment and so on; I think this is quite correct. I have lived with professors for a long, long time and this question of autonomy and what they work on is a very ticklish business.

Actually to permit students to go into a government laboratory on a campus can be quite a debatable point. I think that somebody has to wield the stick, you see.

The Chairman: I wonder, Dr. Duckworth, if you could not expand a little bit on the internal organization that you have at your

university to consider your research programs?

I was impressed during this week by the representations we have received here from various universities. It seems to me that they tend to come mainly from science, the natural sciences and engineering.

I wonder why this is so?

I was also wondering if these groups that you have within your universities to discuss your research programs could perhaps in the future expand a little bit in their scope. Could they also consider occasionally, or perhaps more or less on a continuing basis, the broad issues of science policy, irrespective of the more specific role of universities within this broad concept of science policy?

Dr. Duckworth: Mr. Chairman, the research board which I described does include amongst its membership quite a few representatives of the social sciences and the humanities. So far I have been anonymous today; I should say, to put it in its best light, that I am a natural philosopher, but I am normally called a physicist these days.

In this group, which is fairly new to us, we do have a forum in which we can discuss the overall research aims of the university. We can consider new proposals that have been made, having in mind that they must be given some priority with other proposals.

For example, the university made two applications to the National Research Council for negotiated development grants. One was in the area of cereal chemistry, for which our province is a natural. The other one was in the area of applied mathematics. Now, before our president would sign these applications he requested the research board to consider these.

In a university there is always a suspicion on the part of the professor of classics that physicists have all the money. Here was his chance to say now, if you receive this grant what does this mean five years from now to the university, or ten years from now? I must say that the proposals were subjected to a very searching inquisition. At the end of it we knew what the ramifications were and it was accepted by all that this was a good thing for the university to do.

We are very pleased with this representative forum that we have. We also discuss proposals in the university budget for expansion. Was this what you had in mind?

The Chairman: Yes, I wanted to know more about this. Would this group, perhaps not in the past, but in the future, discuss the broad issues of science policy?

You see, this committee of ours is, of course, a special committee, but we certainly do not feel that we will be able to answer all questions satisfactorily for all time, so we envisage that this exercise by the Senate will be a continuing exercise from now on.

I think it is a very desirable effort, but it seems to me that if the academic community was doing that too and the parliamentarians were in a position to always be able to seek the advice of the academic community on broad issues of science policy, including, of course, the role of universities in that field, that we would be much more together than we have been in the past in this global village of ours.

I wonder if your board could expand its activities to occasionally looking at the global picture as well?

Dr. Duckworth: I think so, Senator; I think the members of our staff who are on this research board would be very pleased to have an opportunity to express themselves on larger matters than university matters. I think if there were a request for expressions of opinion this would be a group that could come forward with opinions.

Senator Cameron: I wonder how many of those there would be?

The Chairman: Yes; is your organization typical of the total Canadian picture, or is it only an experience that you have launched in your university?

Dr. McCalla: At the University of Alberta we have not such a formal group, but perhaps somewhat analogous is our academic development committee to which the applications for negotiated development grants are referred. This is considered in the context of all the new developments in the university. So I think it serves a similar function.

On the other hand, the question I wanted to ask you, Mr. Chairman, was that Dr. Hunka and I have been here for the three days. I feel very strongly that it might be worth while, and it might be of some value to your committee, if when we get back home we call together the original committee to review what has gone on here. We would put emphasis on some of the questions that have been asked repeatedly by members of your

committee and submit to you an addendum to our original brief. Would this be useful?

The Chairman: Oh, yes. This has already been suggested by Dr. Burt from New Brunswick. I think this has been the process of gradual collective learning this week. This is, we hope, as far as we are concerned, only a first phase in this process which I believe for the good of Canada should from now on be a continuing process of exchange and consultation.

I think it would be useful for those universities who have such boards and such an integration of their research program and research policy to expand on this. I do not think that all universities in Canada have such an organization which, of course, would be most useful for us and, I think, most useful for individual universities and perhaps regional universities.

Dr. Forward: Mr. Chairman, we do have a committee appointed by the president, the president's committee on research policy, at the university of British Columbia, consisting of approximately 15 senior members drawn from the various sciences, also from law, history, psychology and the arts. One member is in the theatre—It is a committee that has a broad view of research in all its aspects at the university.

The Chairman: How often do you meet?

Dr. Forward: Rather infrequently; it was that committee that met to discuss and prepare this brief for this committee. We will be meeting again in July. We meet about two or three times a year; it is not a regular thing. The questions that have been talked about here are matters that should be brought before that committee and will be brought before them. So, as Dr. McCalla has said, we hope that we might think further on them and comment again.

The Chairman: I strongly believe that if we cannot organize participating democracy in the field of science policy we will not get that kind of democracy in other fields.

Dr. Duckworth: Nine of our members are elected; they are not appointed by the president.

Dr. McCalla: I am interested in our academic development committee, which has the responsibility to make recommendations to our general faculty and senate.

This committee meets once a week, Mr. Chairman, the year round.

Senator Cameron: I suspect, Mr. Chairman, that while they may not have this formal, named organization that all universities have some arrangements for, it might be useful if they were made more formal and assumed a more important advisory role in terms of the national structure.

Dr. Currie: Mr. Chairman I think we are breaking ground in Saskatchewan; we do have council committees, one for the natural sciences, one for the social sciences and humanities. These are appointed by council, or course. By this we mean our academic senate in some cases.

Because of the Macdonald report I called both together and served as chairman for a discussion. I think it was generally agreed that a discussion along these lines was a very good thing. A motion was passed that from a strategic point in the campus we should have controlled documentation.

That is, very few of the people had seen this report yet; a lot of them know about the proceedings of this committee here, which has now reached a pile so high, and would like to see them.

There are many other pieces of paper that are coming out, so I think this is a breaking of ground along the lines which you are suggesting here, that once we can get the documentation so that people see what is going on and then call these meetings, we will get a constructive dialogue.

Unless we get this documentation, this sort of information, people come who have not done their homework so that pretty soon they break up and are not too happy.

The Chairman: For us it was, of course, a new experience; it was a new field for us, so we felt that we had to go through the university presidents. Very often it is not the most effective way of direct communication, because they are involved in so many other things.

As a result of this week if we could have for each university the name of someone with whom we could remain in contact and send material to, I think that liaison would perhaps be much more effective than it has been for this particular occasion, but we are only establishing a precedent now.

Also, when we have special requests we could communicate directly with this man.

Dr. Currie: I agree wholeheartedly with you, because I think the first communication for a brief from universities came to the president, at least in our campus it did, and the president was busy with many other things.

About two weeks later it got to my desk and he said, Currie will you please think about this. Pretty soon, you see, it is March 1st and you people want some pieces of paper.

Senator Cameron: Mr. Chairman, I do not want to monopolize the time, but I do not want to switch off this particular aspect.

I want to put a caveat on two areas that we have hardly touched. They have been referred to quite frequently:

One is the role of the computer and its implications for science policy in terms of cost, equipment, and so on.

For example, yesterday Dr. Robinson suggested that a university professor might get a grant from some unknown source, say, \$10,000.00, and it would involve \$100,000.00 worth of computer time. I suspect this is happening in other places. There are long range implications in this.

I know that there is one expert here on the computer and maybe more. I am referring to Dr. Hunka.

Secondly, there has been reference time and again to the division of the funding. That is the universities do not want the federal funds to go through the provincial government. Again there are long range policy implications in this.

So, some time this afternoon I would like to see this discussed. I think I had better keep quiet now and leave some time for my colleagues.

The Chairman: I lived for some years under the rule of a provincial government, so I can very well understand the point.

Senator Carter: I have no specific questions and it is getting so late; I do not think it would be worthwhile putting a question right now, but I have some. I would like to express this idea, because I have duty in the House and I might not get here at the beginning, maybe not until 4 o'clock. I was hoping that when we have this plenary session—we have got a lot of ideas and there has been a lot of consensus and a lot of disagreement on points—we could evolve some principles which we could apply which would guide us.

While they might not agree on details, they might agree on principles.

The Chairman: I would be surprised if we could reach even that this afternoon. In any case, it was not the purpose of our meetings this week. The delegations could go back and think about their own re-organization in their respective universities and perhaps in their respective provinces, so as to provide in the future for more liaison, more dialogue. Also in the light of the discussions of this week they could send us back any kind of material that they want to send us. You may be sure that these will be very carefully considered by the committee when we begin to prepare our report.

Senator Carter: Could I give just one example of what I had in mind when I said principles? Somewhere there is a division of responsibility: Research is the responsibility of the university because of its teaching function. It is a part of the teaching function of the university, a part of its function to generate new knowledge, which is a university's function.

Then there is the government's responsibility to at least, as everybody has put it forward here, maintain individual creativity in the field of science. The government is more likely to place, and this is what has happened I think, because everybody has complained about it, undue emphasis on the material sciences and perhaps not enough on the social sciences and the humanities.

So you have these problems of the basic versus the applied, versus innovation, and you have this between the natural sciences and the social sciences and between the social sciences and the humanities. Surely we should be able to develop some principles which would guide us to where the breakdown in responsibility should be?

I do not say we could get it, but it would give us a better idea when we come to assess all this mass of information that we have before us.

The Chairman: We will see what happens. I will ask a final question of Dr. Forward: I would like to know what would happen if a Canadian PSAC were to be established; what happens to the Science Council as it exists now?

Dr. Forward: Mr. Chairman, I am delighted that you asked that question; I was hoping somebody would.

I think the Science Council as it is presently constituted has some wrong concepts. Perhaps I should not say this; I was the one who drafted the form and basis of the present Science Council.

The Chairman: I have drafted a lot of things that I re-drafted afterwards.

Dr. Forward: It is time to re-draft. The problem with the Science Council is that they are neither fish, flesh nor fowl at the moment. They should be able to be free to advise, to warn, to express alarm, to chide, to do all these things quite freely and without any concern for what the people who are in the government are thinking about at the present time. You cannot do that if you have government officials on the Council, because they inherently and basically must influence the thinking. They have access to privileged information; therefore the Council cannot come out and speak its own mind freely. So the Council should be changed and have no government members on it.

The Council then is the counterpart of the Economic Council. It can say anything it likes to anybody and make studies for long term growth in the future, where we should be going and what we should be doing and say so in no uncertain terms. It could develop studies of data, information and so on.

The PSAC committee which I talked of is an internal committee which has access to government classified information.

The Chairman: It would not issue public reports?

Dr. Forward: Not necessarily, but certainly it could make little studies on its own if it wanted to, to acquire information for its own purposes. In general its advice would be internal advice through the Science Secretariat to the Minister for Science, who would be chairman of this Privy Council committee just as there is, as I suggest in the diagram, the committee of deputy ministers.

Of course, they have direct access to the ministers who are on the Privy Council anyhow, but as a committee it can operate, if they wish to do so or find themselves capable of doing so.

The Chairman: If they could find a catalyst that would force them to meet.

Dr. Forward: Yes. There again I look on the Science Secretariat as being not a group that initiates studies, but that assembles from all this and from the Treasury Board, from the Department of Finance, from political sources if they like, the material that they present to the minister so that the decision-making body has information from a number of sources, not just one person telling them something, but all sorts of groups of people.

Thus, through the PSAC committee and through the Science Council we would have the opportunity for the scientific community to feel that it has a part in determining policy and what goes on.

I do not think it feels that way at the present time.

The Chairman: If you, Dr. Forward, because of your experience in the Science Secretariat, feel like submitting to us personal views on any of these matters that you have not been able to express here today, or in your memorandum, we would be delighted to have them.

Dr. Forward: Thank you very much, Mr. Chairman.

The Chairman: Thank you very much.
The meeting adjourned.

APPENDIX 82

Brief submitted by John F. Postma, M.A.(Ottawa), M.A.(Carleton),
of the Research and Liaison Office for
Academic Development, Notre Dame University
of Nelson, British Columbia,
on behalf of the University,

to The Special Committee on Science Policy
of the Senate of Canada,
February 26, 1969.

Introductory Remarks

The letter, dated December 20, 1968, and sent on behalf of the Senate's Special Committee on Science Policy to the Registrar of Notre Dame University of Nelson in British Columbia, was recently referred to this office.

In view of the nearness of the deadline set by the Committee for receiving reports and in view of the fact that, at this time, appropriate and detailed research material related to the Committee's terms of reference is somewhat scarce, I have decided to submit a brief report on the limited subject of "the broad principles... of a dynamic and efficient science policy for Canada" (No. d in the Committee's terms of reference).

Put forward for re-emphasis in this brief are those elementary distinctions and general principles which will help to keep our approaches to the problems sorted out and which may thus be indicative of the directions in which we should continue to search for solutions.

I am aware of the difficulties in maintaining the distinctions made below. In a given instance, they may have to be applied, unavoidably, with some degree of arbitrariness. However, I think that allowing them to be obscured or to be set aside entirely will only lead to further chaos and to an ever increasing waste of those financial resources in Canada which are spent on research.

It must be possible to distinguish, however broadly, between:

- a governmental type of research;
- a university type of research;
- other research, practical, applied or technological;
(Cf. business, the professions).

1. Governmental type of research

Engaged in and fully financed by a government, it relates immediately and directly to the public interest, the common welfare;

- a) in the area of federal responsibilities and operations;
- b) in the area of provincial responsibilities and operations;
- c) in the area of municipal responsibilities and operations. (1)

Several observations are in order here:

- The term "responsibilities" is used advisedly. It is not synonymous with "powers". Responsibilities will necessarily overlap at different levels. Inevitably, there are federal aspects even to areas of immediate provincial concern and the same hold true with regard to municipal concerns in relation to their respective provincial and federal aspects.
- Thus, we must recognize the inadequacy and intrinsic unworkability of an inflexible "division-of-separate-and-autonomous-powers-approach" to Canadian federalism.
- It is my considered view that, unless we wish to end up with a number of loosely federated but very separated countries, a defensible continuation of Canada as a one and distinct country can only be premised (with any degree of safety) upon:

- 1) a measure of success, or the common will to succeed, in building out of the separately incomplete cultural mainstreams within Western civilization, namely French and English, not just a state of coexistence, however peaceful, but a new and integrated approach to social and public life, wherein these traditions (not to mention others) can be allowed to permeate and supplement one another:

(1) For interesting comments on municipal responsibilities, powers and local government generally, see the Ontario Economic Council Report of February, 1969, on the crisis of urbanization. Even their observations and recommendations, however, are valid only within the framework of a traditionally preponderant approach to Canadian federalism which needs to be critically re-examined.

- 2) the equivalent of a highly de-centralized and flexible, unitary form of government. I think that we must accept this.
- unless arguments based on a recognition of "the politics of the case" can be allowed to excuse any degree of chaos and cost, and
 - unless we are willing to leave the essential issue of Canadian unity wholly to chance, to the vagaries of unpredictable, 'ad hoc' political settlements and economic agreements, or to divine Providence without helping Providence along a little!

With regard to governmental type research, ways must be found to coordinate all such research effectively, as between all participating levels of government and administration. The appearance of the Secretary of the Treasury Board, S. Simon Riesman, before your Committee on Thursday, February 6, of this year, has undoubtedly convinced the members of the Committee (if they needed to be convinced!) of the chaos even just within those research areas that are presently considered to be of legitimate and direct federal interest. We suffer from too many "coordinating" bodies operating with an indefensible degree of independence from one another. We shall all be surprised if the Cabinet, which is currently engaged in an attempt to draw up a policy of coordination for the benefit of the President of the Treasury Board (the Minister theoretically responsible for the co-ordination of the total government scientific program), will wait to take the report of the Senate Committee on Science Policy into account! (2)

It may often be necessary or advisable to use existing university facilities and talent for such governmental type research. Full compensation for such use should then be arranged on a 'pro rata' basis between the participating levels of government or administration. (3)

2. University type research

Basic research in pure science or the humanities, more proper to the University in the light of what may be considered the original and lasting academic responsibilities of the Universities. (4)

(2) House of Commons Debates, February 13, 1969, p. 5465.

(3) In such cases we would have an area of "university work" where the central issues related to the broad and abused concept of "academic freedom" have only limited application. Such issues would only be relevant regarding those aspects of the work which are directly related to university work and to university responsibilities proper, namely liberal arts and science work and the basic research in these areas.

(4) Dr. J.A. Corry, speaking at U.B.C. recently, referred to "fundamental research" engaged in by the university as distinct from "the more practical, short-run type of research conducted by governments and industry." He did not get around to distinguishing, within the latter category, between public and private research, as we have done here.

For academic and economic reasons even this type of research cannot be independently and autonomously engaged in to an unlimited degree as a matter of practical principle. Even this work needs to be coordinated in its organizational and financial aspects 1) always and in the first instance by the universities themselves, and 2) if necessary, with discreet "encouragement" from the respective levels of government, acting in concert.

This type of research, like any other activity more proper to the university, is in the first instance normally supported by a combination of student fees as well as private and public funds. We see no clear alternative to this. Perhaps some of the private and public support should be more particularly earmarked for particular research purposes. In any case, all such support should be coordinate to be fully effective and proportionately just. We lack the structures for such coordination, by and large.

3. Other research: practical, professional or business research; applied or technological research in or research directly oriented towards practical application, in the private sector.

Such research should be financed, wherever it takes place, on a 'pro rata' basis, by the sponsors and (or) beneficiaries involved, e.g. a government, a business or a profession, as well as by the University whose talents and facilities may, for practical reasons, happen to be used for this type of work.

It would be simplistic to assume that, just because much of this work happens to take place on a university campus, it therefore is a responsibility proper to the university, to be supported in the same way as e.g. the university's regular liberal arts and science programme.

Professional or business support, if necessary, may have to be "encouraged" by public incentive, the respective levels of government acting in concert. The principles of professional autonomy or of business competition can only be carried so far without chaos and waste becoming indefensible, or, on the other hand, without our losing sight of the fact that a given university may be an essential feature of a natural growth centre in relation to a larger, economically and culturally underdeveloped region.

Out of all the conclusions which could be drawn from this Brief, one may be selected for special emphasis: the glaring lack, especially on a national scale, of effective master-planning and of appropriate structures for coordination between universities, the various levels of government, business and the professions, with regard to post-secondary education generally and with regard to research in particular.

We are aware of the many obstacles. We see no easy solutions. With regard to the matter of structures, one would hope it to be possible to fashion an effective planning and coordinating body out of some of the membership of such bodies as Treasury Board, the Education Support Branch in the Secretary of State Department, the National Research Council, The Science Council, The Defense Research Board, The Canada Council, The Departments of Regional Development, Manpower and Immigration, Industry, Trade and Commerce, Forestry and Fisheries, Mines, Energy and Resources, The A.U.C.C., the professional and business (research) associations at the national level, and so on.

Such a planning and coordinating body should be capable of setting general patterns and guidelines for the development and operation of the appropriate, equally pluralistic structures at the provincial level.

In anycase, we hope that Canada's basic approach to these problems will amount to more than ineffectual tinkering. It is hoped, instead, that it will be possible for us to address ourselves to these problems in a forthright, imaginative and creative manner, while not losing sight of the distinctions and principles re-stated in this Brief.

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APPENDIX 83

THE UNIVERSITY OF BRITISH COLUMBIA

SCIENCE POLICY

A UNIVERSITY VIEWPOINT

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A Brief Submitted to the

Senate of Canada

Special Committee

on

Science Policy

P R E F A C E

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This brief, prepared in consultation with committees, faculty groups and individuals in the University of British Columbia, presents brief background statements and specific recommendations concerning:

- Separate Federal Government support for research and graduate studies
- Allocation of Federal funds for capital purposes
- Extension of Federal department advisory committees
- Expansion of university research "Centre" concept
- Mutual arrangements for accommodation of research personnel
- "Mission-oriented" research
- "Institutional" type research grants
- Uniformity of research contract procedures
- Policy on "out-of-pocket indirect costs" of research
- Establishment of Council for fields not now supported
- Capital requirements for the arts
- A structure for providing advice on science policy in Canada

THE UNIVERSITY OF BRITISH COLUMBIA

Science Policy

A UNIVERSITY VIEWPOINT

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INTRODUCTION

1. Every country in every corner of the world is daily made more aware of the urgency, the impact and the inevitability of the surging growth of science and technology. But the advances that result are made only with the consent and support of the hundreds of millions of people whose lives are moulded and affected by them in the social, economic and political sense.

2. It is little wonder then that governments are deeply concerned with the need to assure that the prodigious influence of technologic change has a quality and character that will most benefit their countries. From this concern has arisen the desire and need to develop a "science policy" under the terms of which basic requirements for technologic progress can be identified, their physical and social implications evaluated, and the optimum allocation of human and natural resources in public programmes be effected.

3. The decisions involved in devising and implementing science policy are among the most difficult that governments are called upon to make, for the factors that influence them are embedded deep within the conscience and desires of the people. Above and beyond the obvious concerns such as physical and economic well-being are those associated with history, with nationalism, racial characteristics, pride, and perhaps even climate or geography.

4. Although the ultimate basis for decision-making in science policy is necessarily political it is especially important that those who are responsible for the decisions have available to them the advice and opinions of the community of science and technology as well as those of the spokesmen for the social and economic components of society. Thus there must be clearly defined paths for information to reach the decision-makers and, indeed, not only one but many well-informed and reliable sources of information and advice.

5. In this realm the universities, because they represent a concentration of advanced thought and because they inevitably influence the ideas and principles of those who now or in later years must be the decision makers, play an exceptionally important role. The universities are destined to produce the professionals, scientists, humanists and others with the quality of scholarship and sense of leadership that will make progress possible: what this quality or this sense will be is certain to be influenced deeply by the graduate research programmes which everyone recognizes provide the chief source of vitality and growth in undergraduate curricula.

6. It is the purpose of this statement to examine briefly selected topics in what may be considered the administrative area of university graduate studies and research support and to suggest courses of action that would be favoured. Consideration is also given to one form of science policy structure which, it is believed, would be effective in providing channels and agencies for advice to government that would remove some of the confusion that now exists and enhance the opportunity for not only the universities but all groups in the community to bring their views to bear on the complex problems of science policy.

7. In the topics here examined it will be recognized that the views expressed are not,unanimous, nor do they represent

a consensus. It can be said, however, that they are favourably regarded by many individuals, committees and other groups in the University of British Columbia.

VIEWS ON SELECTED TOPICS

Federal-Provincial "Cost-Sharing".

8. The Federal Government has adopted a policy of 50-50 "cost-sharing" in post-secondary education. However well (or poorly!) this formula may be suited to the support of day-to-day operations in the university it is totally inadequate for supporting research and advanced studies at the post-graduate level as these can only be fruitful if set in a much wider context than is possible on a parochial level. Investigation of new knowledge must be undertaken on at least a national basis, not only to avoid wasteful duplication, but to ensure the fullest development of material and human resources.

9. The Federal Government must accept independently the major responsibility for supporting research and advanced studies at the post-graduate level in Canadian universities. One aspect of support which must be recognized is that the most critical need now, and in the foreseeable future, is for additional space to accommodate faculty and students in post-graduate studies and research. The time will soon come - if indeed it has not already arrived - when effective expenditures of operating funds will be restricted by availability of working space.

IT IS RECOMMENDED:

10. (a) *That the Federal Government reaffirm and strengthen its stated intention of supporting research and graduate studies in the sciences, professions and humanities, independently of the "cost-sharing" programme: on a different basis, by different procedures and at a level consistent with national needs.*

(b) *That in supporting research and graduate studies the Federal Government policy be such that funds can be allocated directly to the universities for capital purposes - for the construction and fitting of buildings. The principle adopted for capital support under the auspices of the Health Resources Fund or that applied in the early days of the Canada Council could serve as a useful starting point.*

The University and Federal Government Laboratories.

11. Government laboratories have been exceptionally well supplied with funds (at a level better than any other country in the world - including the USA) and have taken on a great deal of basic research that the universities quite properly contend could and should be done in the university environment, where relevant teaching stands to benefit. This has been the cause of much controversy and misunderstanding over many years. Government agencies and departments involved in science have buildings, equipment and staff in quantities that far exceed the most optimistic hopes of all the universities combined.

12. It is obvious that government laboratories and civil service establishments, already large, are not going to diminish in size and some means must be provided to staff organizations with well trained and fully qualified professional people. The prime source is the university and if people are to be attracted to the fields of interest of departments and agencies a two-way communication must be established between the universities and the agencies. The agencies must necessarily support work in the universities that is related to their missions and the universities must inform themselves of these national needs.

13. Whatever the liaison may be between government agencies and university departments it must be clearly recognized that the university's objectives are centred primarily on teaching,

training and research: the discovery and dissemination of knowledge. Research required by governments may be undertaken by the university as a public service in those cases where only the university has the variety and depth in the relevant areas of knowledge.

14. One useful way to extend the association between National (Federal Government) Laboratories and the universities is the establishment of additional "Institutes" or "Centres" in the universities. The centres should be an integral part of the university structure engaged in graduate studies and research but supported by funds provided by the National Laboratory. They should be concerned with attracting and training people in the research field of the National Laboratory but their research programmes would not be determined or directed by the National Laboratory. A prime component of the agency budget should be "free funds" for financing the operation of the centres.

15. Another scheme which has already been used to a limited extent is for the Federal Government to station personnel in university laboratories where they work side by side with faculty members on research. A corollary of this is the arrangement whereby the Federal Government builds a building on or near a university campus and university faculty members and graduate students are invited to use the physical facilities thus provided and work beside the Federal Government staff.

16. "Mission-oriented" programmes of the Federal Government are frequently such that some of the work can be very effectively carried out in university laboratories. This has the dual advantage of bringing realism to professional and applied programmes in the university and of introducing graduate students to the field of interest of the government department or agency. It is probable that programmes of this kind, especially those of fairly long term, could be suitably carried out on a contractual basis.

IT IS RECOMMENDED:

17. (a) That more National Advisory Committees be established to assist and advise government departments and agencies in formulating research programmes and that, to improve the liaison between government and the universities, a large proportion of the membership of these Committees be drawn from university faculties.
- (b) That the concept of "National Laboratories" and related university research "Centres" be recognized and that active steps be taken to expand programmes of this kind.
- (c) That the accommodation of government personnel in university buildings and of university personnel in government buildings, with mutual access to facilities, be approved and encouraged whenever this arrangement can be beneficial.
- (d) That "mission-oriented" agencies of government be encouraged to have suitable segments of their work carried out in professional and applied units of the university, utilizing research agreement procedures where these appear suitable.

Research Grants Administration.

18. The magnitude of the sums provided by the Federal Government for research in the universities is such that it has outgrown the system that served well when amounts were smaller. A new and more effective form of granting agencies is required for the proper co-ordination and allocation of funds.
19. This topic is complex and its effects are far-reaching; a detailed assessment of the most important features, with appropriate recommendations, has been submitted to the Macdonald Study Group of the Science Council/Canada Council on behalf of the University of British Columbia. As the results of

this Study are being reported substantially contemporaneously with the submission of this brief it is felt that presentation and discussion of these earlier recommendations would be redundant. There are, however, one or two points that merit some comment.

20. For one thing, increasing attention must be given to the principle of "institutional" grants as distinguished from "project" grants to individuals. Although it has been reasoned that the best way to ensure that research funds are spent to the best advantage is to "support the able man" whose performance can be easily evaluated there is a growing realization that the performance of a group or team is equally susceptible to evaluation. If a larger proportion of available research funds is made available to the President, Deans, Directors or Department Heads there is a better possibility that the objectives of the university will be consistently served. Otherwise if all funds go to individuals there is a strong possibility that a "transfer of allegiance" will take place and that the individual will slant his work and project proposals in a direction that he thinks will gain the favour and approval (and support!) of the granting agency without necessarily having any regard for the broad principles, philosophy or needs of the university.

21. In some cases it has been found useful for government agencies to have specific projects related to their mission carried out in university laboratories. Usually the project is administered under the terms of a contract between the university and the agency, defining terms and conditions relating to payments, patent rights, overhead, publication of results, etc. In some ways the contract has proven to be a cumbersome instrument, as much as anything else, because government departments and agencies all seem to have different policies and practices in arranging contracts. It may well be that a type of "research agreement"

could be worked out, that would be uniform for all agencies, and which would involve less administrative complications in government and university alike.

22. Indirect costs - unquestionably when a research grant is received by an individual, a department or other group the university incurs expenses not specified in the grant but which include purchasing, accounting, stenographic services, library and all the items associated with providing working space. Many people would like to see these items fully covered by a supplementary grant of some kind, in lieu of "overhead". It is very difficult to calculate the true indirect costs arising from a research grant or research agreement. In industrial research a figure of 100% to 150% of salaries and wages is thought to be realistic. In the humanities, the chief indirect cost of research to the university is that of the substitutes who are paid to do the teaching of faculty members during a leave of absence during which they may be undertaking subsidized research. The cost to the university may be as much as 60% of the faculty member's salary.

23. It may perhaps be of interest to record that a careful study by the Federal Audit Services Branch in the University of British Columbia determined the "indirect cost" here to be approximately 50% of labour cost in a research project. As the Federal Government already pays 50% of university operating costs it is not unreasonable to suggest that 25% of labour cost is true "out-of-pocket indirect cost" to the university for a research project. With labour cost representing 60% to 80% of the cost of a research project it may be said that 13% to 17% of the overall cost is "out-of-pocket indirect cost". Thus, on the average, the inclusion of a 15% supplementary "administrative overhead" payment with grants would fully cover these costs.

IT IS RECOMMENDED:

24. (a) That the principle be adopted of increasing modestly the proportion of funds granted for "institutional" purposes and for "team" and "institute" programmes: and that it be recognized that these programmes, like projects carried out by competent individuals, should have continuity of support.
- (b) That steps be taken to establish uniform "research agreement" procedures and conditions for all government agencies and departments dealing with universities.
- (c) That all grants and research agreements made by the Federal Government carry an amount equivalent to 15% of the total sum involved for payment to the university to cover "out-of-pocket indirect costs" incurred in operating the research projects being supported.

Gaps and Needs.

25. In 1967-1968 the total amount provided directly by grants and sponsors for research in the University of British Columbia was almost \$9,100,000. In addition unidentified amounts of considerable magnitude were provided indirectly by the university by way of salary payments to professors supervising research, to technicians, and a variety of ancillary services such as secretarial, accounting, purchasing, as well as heat, light, telephone, etc. In the current year the identifiable comparable figure for direct research expenditures will be over \$12,000,000. In 1967-1968 some 72% of the funds were derived from Federal Government sources; 6% from B.C. Government sources and 22% from private sources.

26. That the sums involved are large is self-evident: that they are large enough or allocated to the best advantage is not at all certain. It might be noted, for example, that of the

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\$9,100,000 available in 1967-1968 the faculties of law, arts, commerce and education combined spent only about \$550,000 - a sum that was equalled or greatly exceeded by each of two or three departments in science or in engineering. In fact about 45% of the graduate enrolment is in the non-science faculties but research funds received are about 6% of the total - a patent imbalance. It appears that more money is urgently needed, particularly at the Masters' level, for the support of students in the non-science faculties who are engaged in research as part of their graduate training.

27. It should be pointed out that one of the features of this imbalance consists in the current lack of research funds for library purchases. The Canada Council grant in 1967-1968 for the purchase of books in the field of the humanities and social science is only \$1 1/2 million for the whole country. The view is strongly held that, in these fields, the purchase of library resources should be regarded as axiomatic, and be treated as the equivalent of purchase of equipment in other fields.

28. In the field of the humanities, and especially in the creative and performing arts there is a growing need for equipment and space. Such resources of equipment and space as film studios and equipment, electronic music equipment, space and equipment for inter-media experimentation and the like have become minimum requirements for competent teaching, research and creative work. If the creative and performing arts at the university are to provide leadership in their field comparable to that given by science laboratories, for example, then this technological revolution in the arts must be recognized both administratively and financially.

29. The lack of research funds and facilities in commerce, business administration and the management sciences is especially critical in Canada compared with the United States, Germany, etc., where great strides have been made in recent years. While in

other countries the new discipline of management science has been highly developed and has given great impetus to business administration in general, the financial plight of the faculties of commerce of Canadian universities has impaired the advancement of this discipline. It is important that in those universities where some strength has developed adequate funds should be made available for research.

IT IS RECOMMENDED:

30. (a) *That in any reorganization of the Research Granting Administration there be at least one Council or comparable granting body competent to evaluate projects and make awards in the fields that have thus far been neglected but that could be advanced by the injection of research funds.*
- (b) *That the capital requirements for books and equipment in libraries, communications media and the arts be given added consideration.*

ORGANIZATION FOR SCIENCE POLICY DEVELOPMENT

31. For long years the amount of money provided for university research by the Federal Government was relatively insignificant in comparison with the large sums voted to government departments and agencies for research and development. As little as six years ago the total amount granted to the universities from all Federal sources was only about \$20,000,000. At that time there were at least five government agencies - NRC, DRB, AECL, Mines & Technical Surveys and Agriculture - that were spending \$30,000,000 or more each on research.

32. But the picture has changed - the universities in 1968-1969 received about \$110,000,000 for research - much more than any of the five large research groups in government. Thus the universities now appear as major "competitors" in the quest for funds, yet they are at a considerable disadvantage when

funds are being allocated in that they have no one at the bargaining table to plead their case. Every government department has its "day-in-court" when the Minister and the Deputy Minister present estimates to the Treasury Board. Universities are represented only indirectly by Ministers and Deputies who have included funds for grants in their departmental or agency budgets.

33. The support of university research, however important it may be, is only one of the facets of science policy in Canada. Looking to the broader horizon it can be seen that in the field of science policy there are two distinct areas:- first that concerned with allocation and administration of funds and second the mechanisms or structure required to provide the advice upon which the allocation or administration can be based.

34. Matters already mentioned in this brief, such as the position and function of the National Research Council, Medical Research Council, Canada Council, the Research Boards and many other Federal government departments and agencies, lie within the area of administration. Members of the University of British Columbia have already expressed views on these topics in briefs presented to the Macdonald Study Group. These are summarized in Appendix B attached and complete statements are available if required.

35. In dealing with the subject of structure for determining science policy consideration must be given to some basic principles. In the first place the difference between advice and administration must be recognized, the two come together only at the point of decision-making. Secondly, in the advice area, care must be taken to ensure that no group, committee, council or other body is in the position of being both advocate and judge. Causes need strong proponents but the case for the other side

must be presented with equal force. Finally there must be a mechanism for assembling the arguments pro and con and presenting them objectively to the Decision-Making Body together with as much relevant political, financial, social and economic information as may be available.

36. A rather extensive examination of the structure for determining science policy in five major countries - France, Britain, Russia, Japan and the United States - reveals an interesting and perhaps not unexpected parallelism and the presence of five main components in each of the five countries. That the structure for providing advice on science policy is sometimes combined with administration is largely coincidental, possibly a reflection of political philosophy and perhaps, where it exists, a source of confusion and some weakness. The five components are:

- Top-level ministerial decision-making body - a group that, having received advice from all sectors of the community, including those having relatively little to do with science or technology, must make the final decision on the areas to be supported, the emphasis to be given each, and the allocation of funds. (In France, the Committee of Ministers; in Russia, the Council of Ministers; in the U.S., the President and Cabinet, etc.)
- Scientific advisers to government - a group of leading scientists, professionals, social scientists appointed by government and operating in a voluntary capacity to review proposals arising from all sources. They occupy a confidential position, in some countries advise on defence matters, and usually have no administrative responsibility. (In France, the Advisory Committee for Scientific and Technical Research, the "Twelve Wise Men"; in the U.S., President's Science Advisory Committee, PSAC.)

- "In-house" government research advisory group - a council or committee of senior officials of science-based government departments responsible for co-ordination of programmes among government departments and for advising ministers on feasibility and effect of proposals from all sources. (In Japan, the Science and Technology Agency; in the U.S., the Federal Council for Science and Technology, FCST).
- Advice from the community of science - the views and interests of the community of science and technology are brought to the attention of the decision-making group (and the public!) in a variety of ways. Not uncommonly there is a body, financed by government, that conducts studies and presents independent proposals and recommendations that have broad public support. (In Japan, the Science Council of Japan; in the U.S., National Academy of Sciences Committee on Science and Public Policy, COSPUO; in the U.S., Congressional Committees).
- Secretariat of officials - in every country there is a small body of full-time professionals in government service who assemble information from all the advisory groups and present these views to the decision-making body.

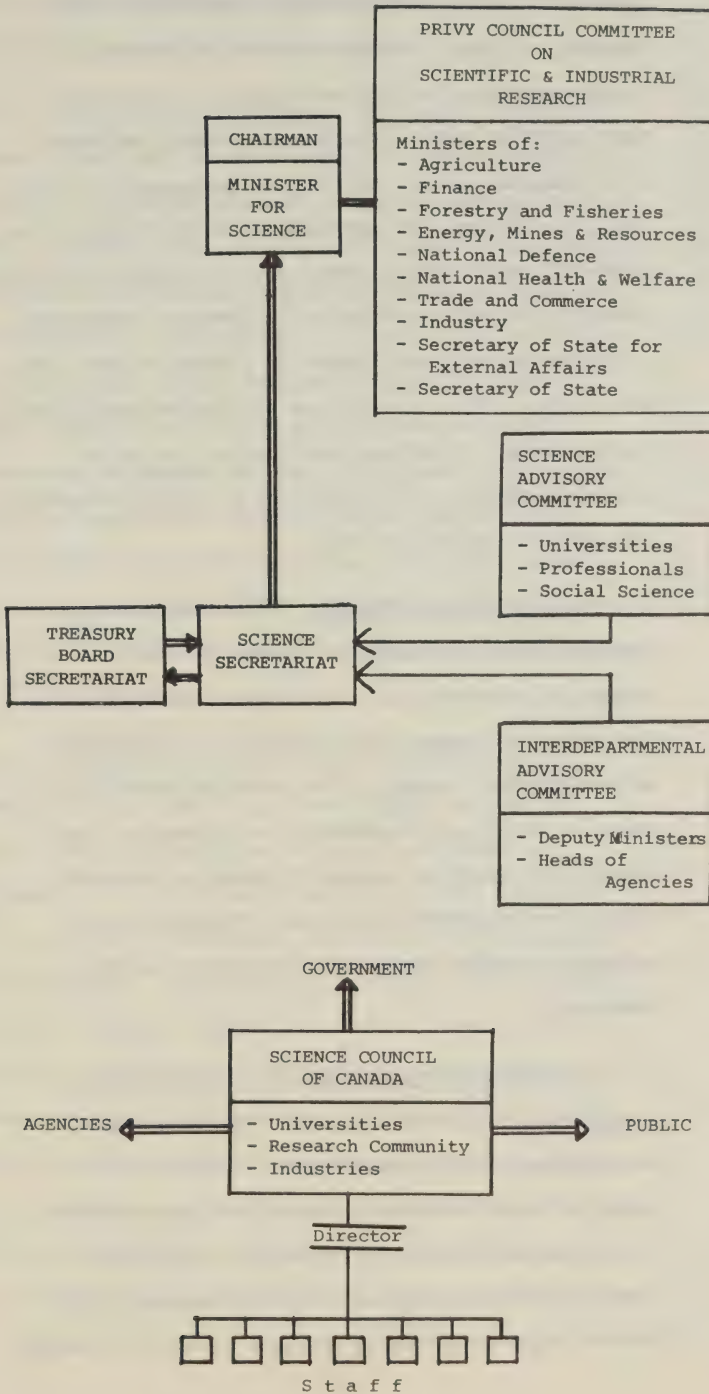
STRUCTURE FOR CANADA

37. It has already been pointed out (paragraph 3) that the decisions on science policy are affected by a variety of complex factors. Because Canada is a unique combination of resources, geography, races, temperaments and needs it is not to be expected that the patterns that have evolved in other countries would be exactly suited for our own. With the thought in mind that the experience of others, especially where substantially parallel patterns have appeared, might serve as a guide;

IT IS RECOMMENDED:

38. *That in Canada the structure for the advisory segment of science policy depicted in the accompanying chart (figure 1) be formulated comprising:*

(Figure 1)
SCIENCE POLICY ADVISORY STRUCTURE



38. (a) The Privy Council Committee on Scientific and Industrial Research - comprising Ministers of Departments involved in science and technology, together with the Minister of Finance, Minister of Trade and Commerce, Secretary of State for External Affairs. To this group there should be added a Minister for Science, who would be the Chairman and who would be the spokesman for science policy (and perhaps the universities) in the Cabinet. The National Research Council, which now is somewhat anomalously created by the Act establishing the Committee should have a separate Act and should report to a Minister other than the Chairman. There is no reason for the National Research Council having a privileged position vis a vis other government agencies. This Committee is the Decision-Making Body reporting to the Cabinet.
- (b) Science Advisory Committee - this would be a new committee comprising twelve to fifteen top level scientists, technologists, sociologists, humanists chosen from outside government who would serve in a voluntary, but confidential, capacity. The committee should have access to privileged information, should meet at least monthly, and should be prepared to advise on proposals arising from government departments, Science Council, university granting groups and other sources in the community.
- (c) The Interdepartmental Committee on Science and Technology - this now exists as the Interdepartmental Advisory Panel, which rarely meets. The proposed committee should comprise the Deputy Ministers and Chiefs of agencies whose Ministers sit on the Privy Council Committee for Scientific and Industrial Research. The terms of reference should be modified to make the Committee

an active body advising the Government (Privy Council Committee) on internal matters and the effects of implementing proposals submitted by Science Council, universities and other public groups.

(d) Science Council of Canada - the Science Council of Canada should function in much the same way as COSPUP does in the United States or as the Science Council of Japan in its "statement" role. To avoid the advocate-judge conflict of interest the Science Council should have no government officials in its composition. It should be as independent as the Economic Council with much the same structure. There should be a full-time paid Chairman and staff conducting independent studies. The Council should be financed by government but should not be dependent on the Science Secretariat in any way. The Council should not have access to privileged information and would thus be free to speak independently and to inform government and public alike.

(e) Science Secretariat - this is a small group of professionals in the Privy Council Office serving the Privy Council Committee on Scientific and Industrial Research. The Secretariat should be directly responsible to the Minister for Science, who would be the Chairman of the Committee. The Secretariat would not initiate studies but would record, assemble and condense proposals and opinions from the Science Council, the Science Advisory Committee and the Interdepartmental Committee on Science and Technology, and from any university or public source, for presentation to the Privy Council Committee. The Secretariat would also be responsible for obtaining available political, financial and economic information

for the Minister and Committee. In a number of ways the Science Secretariat should be the counterpart of the Treasury Board Secretariat. There should be the closest liaison and exchange of views and information between the two.

39. The success that has attended the hearings of Select Committees of the House of Representatives and of Special Committees of the Congress and of the Senate in the United States in bringing out volumes of information and opinions provided by the community of science and those whom it affects has proven most useful in helping to form public policy. In Britain the "Parliamentary and Scientific Committee" comprising about 200 Members of Parliament and of the House of Lords in all parties together with some 300 members appointed by scientific and professional societies offers an interesting forum for broadly based discussion of topics in science and technology. In Canada, until recently, there has been no such forum: in our view the Special Committee of the Senate on Science Policy provides precisely the kind of opportunity, that has long been lacking, for open and objective examination of matters that are of the gravest importance to Canada now and in the years that lie ahead. It is our hope that the activities of the Special Committee can be continued indefinitely, in a permanent form, thus providing yet another source of information for those who are faced with making decisions on science policy.

APPENDIX A

DATA RELATING TO
THE UNIVERSITY OF BRITISH COLUMBIA

- - -

The University of British Columbia was established by Provincial legislation in 1908, first opened its doors to students in 1915 and moved to the present 1000-acre campus on Point Grey, adjacent to Vancouver, in 1925. It was the sole public university in British Columbia until 1963 when a new Universities Act was passed by the Legislature making provision for sister institutions all of which, like the University of British Columbia, are non-sectarian in character.

The Faculties

In the University there are thirteen faculties and a number of schools. Training in most of the learned professions in British Columbia is provided exclusively by the University of British Columbia. Also, most of the post-graduate students enrolled in British Columbia universities are to be found in the University of British Columbia.

The enrolment of full-time students at 1st December, 1968, was:

| <u>Faculty</u> | <u>Number Enrolled</u> |
|------------------------------------|----------------------------|
| Arts | 5,887 |
| Science | 3,387 |
| Agricultural Sciences | 217 |
| Applied Science | 1,490 |
| Commerce & Business Administration | 1,021 |
| Dentistry | 90 |
| Education | 3,581 |
| Forestry | 218 |
| Law | 488 |
| Pharmaceutical Sciences | 141 |
| Medicine | 354 |
| Graduate Studies | 2,457 |
| Unclassified and qualifying | <u>406</u> |
| TOTAL | <u>19,722</u> |

Special Committee

| | |
|------------------------------------|-------|
| Part-time credit courses | 2,438 |
| 1968 summer session credit courses | 5,664 |

The total number of graduates from the University since its establishment is 45,241.

The Staff

| | |
|--------------------------------------|--------------|
| Full-time teachers (12 months) | 1,325 |
| Lecturers (8 months) and lab. assts. | 2,532 |
| Administrative, technicians, etc. | <u>2,073</u> |
| TOTAL | <u>5,930</u> |

The Plant

| | |
|---|-------------------|
| Area of campus | 1,000 acres |
| Total gross area of floor space | 5,822,426 sq. ft. |
| Academic and administrative floor space | |
| (In 52 permanent buildings; | |
| 47 semi-permanent buildings; | |
| 120 former army huts) | 4,058,580 sq. ft. |
| Total value about: | \$ 100,000,000 |
| Student residences: | |
| Beds | 2,854 |
| Units for married students | 406 |
| Student Union Building (financed by students) and opened October 1968 | \$ 5,000,000 |

Finances (1968-1969)

| Income Source | Amount (\$ million) |
|---------------------------------------|------------------------|
| Student fees | 9.3 |
| Province of BC | 31.2 |
| Sundry | 1.9 |
| Research grants | 11.4 |
| Gifts and grants for special purposes | <u>2.0</u> |
| TOTAL | \$ <u>55.8</u> |

| Expenditures | Amount (\$ million) |
|--------------------------------|------------------------|
| Direct Academic | 28.4 |
| Academic Services | 7.4 |
| Administration, Physical Plant | 6.0 |
| Research | 12.0 |
| Special projects | <u>2.0</u> |
| TOTAL | \$ <u>55.8</u> |

APPENDIX B

BRIEFS SUBMITTED TO
THE MACDONALD STUDY GROUP
BY
THE UNIVERSITY OF BRITISH COLUMBIA

- - -

- I. University Committee Submission - November 1967
- II. Faculty of Arts Submission - April 1968

APPENDIX B

No. I

Summary of Statements in University Committee Submission on
"Support of Research in Universities"
to the Macdonald Study Group - November 1967

In this statement research is defined as being:

"work carried out by students and faculty at the post-graduate level in any area of scholarly endeavour, including the natural and social sciences, the arts and humanities and professional studies".

1. University Research - a National Asset

"The conduct of post-graduate studies increases the level of awareness (of foreign science) and hence the ability to appreciate, adapt, and apply ideas and discoveries made elsewhere in the world. The universities, as centres of basic research producing material that is freely published throughout the world, assist materially in discharging this country's international obligations in many fields of thought and discovery."

2. University Research in the Community

"Universities provide direct benefits and service to the community by clinical, or consulting, or research activities. A serious effort must be made to improve lines of communication and mutual understanding that will enhance these benefits."

3. Size of Graduate School

"There is as yet no indication of the upper limit in number of graduate students or of the proportion of first degree students who will (or can) continue to graduate studies."

4. Federal Government Commitment to Research Expenditures

Federal Government must assume major responsibility for support of graduate research independent of "cost-sharing" and must be prepared to allocate funds for capital expenditures on buildings and facilities.

5. Universities and Federal Government Laboratories

Closer association between government and universities urged, also extension of "National Laboratory" and university "Centre" concepts and the inclusion of larger

numbers of university personnel on Federal department and agency advisory committees.

6. Research Grants Administration

Suggest the creation of a "University Research Grants Board" having the responsibility of channelling funds to some six "Research Councils". The Board would not itself make grants and would exercise no control over individual government department extramural programmes.

The Research Councils proposed are:

- Science Research Council - natural sciences
- Health Science Research Council - medicine, etc.
- Engineering Research Council - applied physical sciences
- Renewable Resources Research Council - forestry, fisheries, agriculture, water, etc.
- Advanced Studies - humanities and social sciences
- New Projects Council - nucleating areas of research

None of the above (nor the Grants Board) to have their own laboratories.

7. Techniques of Grant Administration

- Project grants
- Institutional grants
- Negotiated Development grants
- Contract policy
- Award procedures
- Review of Proposals
- Student support (scholarships)
- Indirect cost policy

8. Salary Policy

Proposed that it be permitted to pay faculty salaries from research grants.

9. Gaps and Needs

- Law - no source of research funds
- Fine Arts - Canada Council should extend
- Education - no source of research funds
- Business Administration - research funds most inadequate
- Medicine - lack of support in clinical research and in studying quality of health care
- Architecture - source of funds uncertain
- Nursing - recognition of character of programme and independent support sources needed
- Engineering - gaps noted in some areas
- Forestry - need for working space and more emphasis on certain applied aspects

APPENDIX B

No. II

Summary of Statements in Faculty of Arts Submission on
 "Support of Research in Universities"
 to the Macdonald Study Group - April 1968

The term research should be defined throughout to mean:

"legitimate scholarly and/or creative activity within a recognized discipline".

1. Organization of Research Support

Monies given in support of research within universities must be distributed by the Federal Government to two separate but equal grant-giving agencies, one for Arts and one for Science. The Canada Council seems at the moment to be an admirably suitable body to act as distributor of funds to the Arts, Social Sciences and the Humanities.

2. Arts versus Sciences

Division of monies by the Federal Government must be reassessed. The disparity between the support of those working in the technological areas and those working in the area of the Arts is extreme, and reflects a radical imbalance in the intellectual life of the community. If the Arts are going to play their part in illuminating and even transforming society, and are not going to simply reflect society as it is, they must have much greater resources at their command. We, therefore, ask for a rapid expansion of support for the Arts until the disparity with what is spent on science disappears.

3. The Objects of Support

The dimensions of the support asked for should be seen to include not only operating grants, but also capital grants for adequate provision of such needs as research institutes, museums, art galleries, film studios and libraries, and laboratory equipment. Clearly a capital grants programme of great magnitude is needed.

With respect to operating grants, the two examples that follow will help summarize the kind of needs the Arts now have.

(a) Library Support: This year the Faculty of Arts at the University of British Columbia asked for \$500,000 in response to Canada Council's invitation to apply for funds to extend research collections. The Canada Council's grant

to 40 universities and colleges amounted to 1 1/4 million dollars. The UBC request suggests the magnitude of support necessary to service adequately library needs across the country.

(b) Faculty Support: There is general agreement that the programme of the Canada Council for senior fellowships, together with the university's sabbatical leave programme, have supported most of those faculty who have proved their ability to undertake research projects. Nevertheless, the problem arises with regard to predictability of such support, and there is still a lack of awareness of the flexibility in support programmes offered by the Canada Council. We recommend that the same provision should be made by the Canada Council as is made by the National Research Council for an added percentage to be given to the university authorities from which grants will be made for special projects, to assist new faculty and to take care of emergency or unseen factors.

The Faculty of Arts at UBC was granted last year approximately \$100,000. Such an amount does not in any way satisfy the legitimate claims of scholars needing to study in libraries, museums, etc., in order to pursue their studies. It would not be difficult to justify an amount of approximately \$500,000 under this heading alone.

4. The Support of Graduate Students

Graduate students must be supported at all years and levels in the Arts. Given the 1967 enrolment of 600 graduate students in the Arts Faculty of this University, and using \$3,000 per student as the norm, the cost would be \$1,800,000. Whereas the shortfall in the support of Ph.D. students is approximately 10%-15%, we know that it is alarmingly disproportionate among M.A. candidates, especially at the first year level.

ADDED - FEBRUARY 1969

Those members of the university who have experience of dealing with the Canada Council are in general gratified by its performance, and would be disturbed by any suggestion of a change in its status or function that had not been very carefully considered and thoroughly debated. We, therefore, urge that the problem of support for research in the humanities - which is in some ways a different problem from that of support for science and technology - be given independent and careful consideration before any change is made in the present status of the Canada Council.

APPENDIX 84

BRIEF
TO
SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE
SENATE OF CANADA

from
RESEARCH BOARD*
of the
UNIVERSITY OF MANITOBA

✱

The Research Board includes nine members elected by the Graduate Faculty, the Director of Libraries, and the Deans of the Faculties engaged in research. Its Chairman and Vice-Chairman are the Vice-President (Academic) and the Dean of Graduate Studies, respectively.

1. Introduction

The Research Board of the University of Manitoba is aware that the Special Committee on Science Policy of the Senate of Canada has considered a number of topics relating to science policy in quite sufficient detail for its purpose. Hence, the present Brief is restricted to five subjects which may have received insufficient emphasis, notwithstanding the fact that they represent important factors in the development of Canadian science.

2. Granting Policy to Maintain Balance between Federal Support for Basic and Mission-Oriented University Research

The three federal councils - the Canada Council, the National Research Council and the Medical Research Council - make research grants without much concern for the direct relevance to Canada of the results of the proposed research. Instead, by supporting good work *per se*, they seek to ensure that the whole spectrum of Canadian scholarly activity is at a high level. Thus, if and when Council-supported work is concerned with the solution of problems of economic, social or cultural

Brief to Special Committee
on Science Policy

concern to Canada, it is almost by coincidence. On the other hand, a variety of Federal and Provincial Departments exist for the very purpose of ensuring that our human and natural resources are developed and utilized for the common good. Examples are the Federal Departments of Agriculture, Fisheries, Transport, Industry, Energy Mines and Resources, Indian Affairs and Northern Development, and their provincial counterparts. In recent years these agencies have initiated or expanded their university grants programs in order to guarantee that more of the research and graduate training that is done in our universities is relevant to the Canadian scene. This is an eminently sensible policy, as it provides a desirable complement to the grant programs of the three Councils.

A possible alternative, that of assigning to a single granting agency the task of supporting both uncommitted and committed research, is a dangerous one. For example, with the present emphasis on mission-oriented research, one might find this consideration beginning to colour all grants. Thus, the nation might lose the high quality of fundamental research which it now possesses, and which is essential to underpin most of the applied activity.

If the present arrangement should continue (as this Brief urges) the ratio of federal support for basic to mission-oriented research in the universities could be rather accurately

Brief to Special Committee
on Science Policy

established by means of the budget. This would avoid the danger of mixing the two considerations -- to the unintended, but possible, detriment of one or the other.

3. Collaboration between Universities and Government Agencies

There could and should be much more collaboration between universities and government agencies than at present exists, especially in the scientific and technical fields.

Such collaboration virtually requires the location of government laboratories on or near university campuses, as is now the case for many laboratories of the Canada Department of Agriculture, Fisheries, Forestry, *et cetera*. This move towards a rational decentralization, in which laboratory sites are selected on the basis of natural regional interests as well as specialized competence in the universities concerned, has a long way to go. Furthermore, it is simply the prerequisite for the subsequent development of co-operative arrangements.

The actual co-operative arrangements may take a variety of forms including:

- a) the inclusion of government scientists in the graduate work of the university with the rights and responsibilities appertaining thereto

Brief to Special Committee
on Science Policy

- b) the establishment of integrated laboratories in which specialized equipment and information are either shared or acquired as a result of joint planning
- c) the participation of government scientists in certain major university studies dealing with problems of national concern.

Amongst the fruits of such collaboration would be:

- i. the development of major research centers dedicated to specific subjects and of a quality that neither partner could achieve separately. Such a center would often be a natural point of stimulation for the corresponding technology-based industry
- ii. the recognition of the necessity for both long-term ("academic") and short-term ("action-oriented") research, and that each must take cognizance of the other
- iii. an increasing awareness amongst students of the problems faced by governments, with consequent willingness on their part to contribute towards their solution
- iv. an improvement in the training of graduate students
- v. a significant saving in the costs of replicating specialized equipment and services.

Brief to Special Committee
on Science Policy

4. Graduate Studies should be regarded as Versatile Training

This section relates to recent predictions that Canadian universities are training too many graduate students in certain specific areas of speciality. These predictions draw attention to a serious flaw in our method of training graduate students.

Although the point is always made in seeking support for nuclear physics (for example) that this subject provides an excellent setting in which to acquire a sound knowledge of the concepts and techniques of physics, the general usefulness of their training is seldom emphasized to the graduate students themselves. Instead they are apt to gain the impression that they are especially trained for the noble calling of nuclear physics and to settle for less would be unworthy of them. The rest of the scientific world might find this attitude tolerable if unlimited positions existed for nuclear physicists -- but this is no longer the case. On the other hand, certain branches of applied physics and many areas of cellular and molecular biology could utilize immediately the knowledge of electronics, of particle detection, of vacuum technique, of computer programming and of data analysis which nuclear physicists acquire as an integral part of their training. A period of acclimatization would be needed before a transplanted nuclear physicist could make a productive contribution in the new setting, but that period would not be long. Although

Brief to Special Committee
on Science Policy

nuclear physics has been chosen as the example, these comments apply equally to many other fields of specialization.

If the versatility of graduate study is properly emphasized, and graduating students are encouraged to exercise their competence without restriction to their fields, the graduate training in Canadian universities could contribute more substantially than now to our national aims and aspirations. In addition, the threatened surplus of students in certain areas of study would evaporate.

5. Need for Greatly Expanded Network for Scientific Information

This section is concerned with the need of scientists and engineers for selective access to the research information that is relevant to their work.

A solution to this problem would appear to be the establishment of regional scientific information centers, as suggested by George Bonn in the 1966 report entitled Science-Technology Literature Resources in Canada. Each such center would be tied in with the National Science Library and would utilize modern information retrieval techniques to provide information to the scientific community of its region. The National Science Library is to be commended for its leadership in this field and is to be encouraged to develop an effective information system of the

Brief to Special Committee
on Science Policy

sort described. Canadian science and Canadian technology will be increasingly dependent upon it.

6. Support of University Research in the Humanities and Social Sciences

The Canada Council, the main funding agency for university research in the Humanities and Social Sciences, does a commendable job in the light of its present rather vague terms of reference and the limited funds available. However, the lack of precision in definition of the nature, areas, and approaches for acceptable research applications is frustrating for many university scholars. It would be helpful if the general types of grants available from the Council were to conform more to the general pattern of those available from the National Research Council and the Medical Research Council. For example, the merit of an application should be judged on the demonstrated competence of the applicant rather than on the details of his proposed research. Also, negotiated development grants could contribute greatly to the growth of centers of specialization.

For many reasons it is difficult to make quantitative statements concerning the effective level of university support in the Humanities and Social Sciences as compared to the Natural Sciences. Notwithstanding, the level of support appears to be significantly lower. The provision of sufficient funds to the Canada Council to remove this imbalance should not be overlooked in any consideration of Science Policy.

APPENDIX 85

BRIEF SUBMITTED TO THE
SENATE SPECIAL COMMITTEE ON SCIENCE POLICY
BY
THE UNIVERSITY OF LETHBRIDGE

This brief note is intended to convey our ideas concerning the desired nature of governmental support for research in the University of Lethbridge and possibly other new or small universities. Here it should be pointed out that the University of Lethbridge has no graduate programs in existence nor planned for the near future.

In a general way we believe that there should be support for a considerable number of small and medium sized research projects, rather than support for a much smaller number of very large projects. This preference means that research in such areas as high energy nuclear physics will not be carried out at the University of Lethbridge.

Support for small and medium sized (It should be emphasized that small or medium sized projects need not be small or medium in terms of intellectual quality or potential value) should cover several areas as follows:

1. Capital equipment.
2. Supplies and services. Supplies includes such items as electrical circuit components, chemicals, biological specimens. Services might include computer costs, commercial chemical analyses, salary for a typist to prepare a long manuscript that cannot be handled in various departmental offices.
3. Salaries for scientific personnel. Most numerous people in this category will be undergraduate students. It is anticipated that most of the undergraduates so employed would work on a full time basis during the summer, but some students might well be employed on a part time basis during the academic year or even

3. Continued.

in the summer. Although it is important to us that this employment makes a useful contribution to the scientific education of our students, it is likely that potential supporters of our research will be more concerned with the accomplishments of these people on whom research money is being spent. Fortunately, there is already considerable evidence from first hand experience of some of our faculty (and many others elsewhere) that relatively inexperienced (but well-trained and well-motivated) undergraduate students can carry out significant research in some areas if they are given appropriate guidance.

It is also important that funds be available for post-doctoral research fellows. In addition to the direct and useful contribution these people make to specific research projects, they can also help us build a general atmosphere of scholarly activity in the entire university.

4. Some funds should also be available for support of travel to meetings, travel to collect specimens, or to use special facilities available elsewhere.

We hope there will also be support for some kinds of "semi-applied" research that are not entirely traditional or currently fashionable in universities. More specifically, we would like to foster research in areas of contemporary significance to this part of the world and also to foster basic, fundamental research in certain fields of technology. An example of the former is an investigation of chinooks being carried out here by a physicist. An example of the latter is an investigation of kinetics of reactions involving calcium silicate. This research is a fundamental investigation of a particular system that is of great practical importance in cement chemistry.

APPENDIX 86

SCIENCE POLICY FOR CANADA

A BRIEF SUBMITTED BY
THE UNIVERSITY OF ALBERTA

to

THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

March 1, 1969.

Introduction

The University of Alberta, acting on a letter from Senator M. Lamontagne, has prepared this brief for submission to the Special Committee on Science Policy established by the Senate of Canada. The procedure followed in preparing the brief was as follows.

A committee of senior faculty members was convened by Dean A. G. McCalla of the Faculty of Graduate Studies with the approval of President W. H. Johns and Academic Vice-President M. Wyman. Members of the Committee solicited suggestions and material from all departments in the university. The submissions from each major academic area - physical sciences, biological sciences, medical sciences, social sciences, education, engineering - were summarized by the appropriate member of the committee and a consensus of ideas submitted to the chairman, who then drafted the report. The draft was considered by the committee and this report, as submitted, is the result of the final consideration by the committee.

The Problem

A large proportion of the total funds available for research and development in Canada has been provided by the federal Government. It is clear from evidence already presented to the Senate Committee and from the discussions resulting from these presentations that it is generally accepted that Canada is not carrying on an adequate amount of applied research and development work, and that therefore the federally-provided funds are not being used to the best advantage. It has been concluded that expenditures on research have not resulted in the degree of innovation that should be expected from the investment. These conclusions are, in general, supported by the Report No. 4, "Towards a National Science Policy for Canada" prepared by the Science Council of Canada.

While most bodies and individuals who have appeared before the Senate

Committee have stated that basic research should continue to receive support, the statement is frequently accompanied by the comment that a much larger proportion of research funds must be directed to applied research and development. It is an easy step from this to the conclusion that too much money is now being spent on basic research.

Universities have traditionally been the source of a large proportion of very important discoveries as a result of curiosity-directed, or basic, research. Since the universities of Canada have been very dependent on the federal Government for research funds, any science policy on a national scale must provide adequate funds for university research which is basic in character. The advance of Canada to the level of a scientific nation of some international stature is largely the result of the early decision by senior officials of the National Research Council that research support for any academic scientist would be determined by his scientific stature and nothing else. Canada's best scientists responded to this challenge and have raised the quality of university research to a high level. Many distinguished scientists have been attracted to Canadian universities and these universities can now offer advanced graduate education as good as that offered by any other country.

The writers of this brief wish to make their position very clear. We agree that much more money must be provided for applied research and development but we also agree with Dr. Bladen(1) and with Dr. Bachýnski(2) that more, not less, money is needed for basic research. It is our definite opinion that Canada must increase its funds for research and must attempt to get more research ideas carried forward through the applied research and development stages and on to the stage of innovation. This will require a larger proportion of research funds for these stages, but the actual dollars required should not, and could not, be obtained by reducing expenditures on basic research.

Obviously, we are most concerned with research carried on at Canadian universities. Much of this research is directly associated with the education programs of graduate students and therefore the funds available to support basic research directly affect these programs. The calendar of the University of Alberta states:

"The essential requirement for the doctorate is the planning and carrying out of research of high quality leading to an advance in knowledge in the candidate's field of study."

Special Committee

The candidate's chances of meeting this requirement are greatest if the research project on which he is engaged is fundamental in nature or has fundamental aspects. This does not mean that it cannot be directly related to problems to be solved or even be a part of a large mission-oriented program. But it cannot be a fully directed part of that program or the candidate becomes a glorified technician.

Universities must therefore develop their research programs as part of their educational programs. It will frequently be possible to make parts of thesis research programs fit into larger applied projects. An excellent example is the work done at the Universities of Manitoba, Saskatchewan and Alberta on the studies of the effects of rust, frost and excessive moisture on the production and quality of wheat grown in western Canada. Many graduate students carried on research for thesis purposes while working on the generally mission-oriented projects coordinated by the National Research Council and the Canada Department of Agriculture. It must be recognized, however, that most of the specific thesis topics were concerned with basic research required as part of the major projects, and not with the specific development of new varieties of wheat or new processes of drying damp grain.

As we see it, then, the problem concerns the adequate provision, in Canada, of research support for all phases of research programs. The funds for such support must continue to be provided largely by the federal Government. If the funds for applied and mission-oriented research are to be directed to a limited number of Government-specified missions, then there must be adequate funds for complementary individual research and much of this will be carried on at universities.

Comments on earlier submissions to, and discussions with, the Special Committee.

Our committee considers it essential to comment on some of the discussions carried on at the Senate Committee hearings.

Dr. Schneider of the National Research Council presented figures on the number of Ph.D.'s in science and engineering each year for the period 1959 to 1968 and projected to 1973. (3) These figures for 1966 and 1967 are decidedly higher than those supplied to the Canadian Association of Graduate Schools (CAGS) by Canadian universities for degrees actually awarded. It seems certain, therefore that the NRC figures are too high and are probably based on the

forecast made by students and departments each fall.

| <u>Ph.D.'s in Science and Engineering</u> | | | | |
|---|-----------------------|-------------------------------|------------|--------------|
| <u>Year</u> | <u>N.R.C. figures</u> | <u>CAGS (degrees awarded)</u> | | <u>Total</u> |
| | | <u>(a)</u> | <u>(b)</u> | |
| 1966 | 580 | 419 | 57 | 476 |
| 1967 | 650 | 513 | 77 | 590 |

(a) omitting medical and health sciences

(b) medical and health sciences only (most of which are not included in the NRC summaries).

The National Research Council projections of employment opportunities are based on existing programs. No account is taken of the staffing needs of technical institutes or community colleges. No account is taken of foreign students who return home.

Dr. Schneider recognized these factors and concluded (p.41) that the numbers of Ph.D.'s expected to be graduated are "not an embarrassment." Nonetheless, the figures shown on p.36 have certainly been used to infer that Canadian universities are, in fact, overdoing advanced graduate work in the sciences. We wish to go on record, most emphatically, that we do not accept this. Certainly in most disciplines, we are still considerably below a desirable level if we are to staff the research effort that nearly everyone who has appeared before the Senate Committee agrees that Canada must mount.

Senator Lang, in the same report, p.41, referred to an article by Dr. Ernest Rudd (4) when he said, "it is strongly suggested that expenditures on pure science are not in the best interests of at least the economic development of any country --." Senator Lang said further that "--if there is any merit whatsoever in these observations -- perhaps the course the N.R.C. has been following in connection with the expenditure of public funds on pure science --- may very well have been a misapplication of funds."

First, we reject the "strong suggestion" in Rudd's paper, as stated by Senator Lang. Dr. Rudd is a sociologist at the University of Essex and his approach to the relative importance of basic science and engineering ignores completely the importance of basic research in providing the initial research results on which engineers act. We suggest that conclusions exactly the opposite to those reached by Rudd are fully documented in the report entitled, "Technology

in Retrospect and Critical Events in Science" (5). The conclusions of this study are listed in the next section of this brief. It is sufficient to quote here that:

"Ten years prior to innovation; i.e., shortly before conception, approximately 90 percent of the nonmission research had been accomplished."

And "In all cases studied, nonmission research provided the origins from which science and technology could advance toward the innovations which lay ahead."

We think that Rudd's conclusions are quite erroneous on these points.

Main Argument

The principal thesis of this brief is that individual scientific creativity in Canada must be encouraged as an essential element of the total Canadian research effort. The development of a national science policy is essentially an attempt by government to channelize the creativity of its scientists towards the realization of preconceived national goals. A major factor in the successful growth of any nation is the maintenance of the collective creative vitality of its citizens at the highest possible level. Since true creativity does not easily conform to the transient political goals of a nation, excessive emphasis on channelizing this creativity may destroy it. As already indicated we support completely the demand that adequate resources be directed to research and development leading to innovations. All too often in the past, ideas which originated in Canada have been exploited elsewhere. You have had some of these drawn to your attention already. Let us cite just one more.

The discovery and isolation of insulin were done in Canada by Banting, Best, Collip and Macleod. Large-scale preparations of insulin were required for clinical testing and Banting initially applied to Canadian governmental and industrial resources for support but to no avail. Banting was invited to the Eli Lilly & Co., Indianapolis, and the director of research offered to set up a pilot plant and to effect rapid industrial application of the insulin purification process worked out by the Canadians. Banting had no alternative but to accept, with the result that insulin became one of the biggest money-maker items for an American pharmaceutical firm.

Earlier, we referred to the document entitled "Technology in Retrospect and Critical Events in Science", (TRACES)(5). The summary includes 11 statements of fact and is as follows:

SUMMARY

This investigation is based on the historical tracing of key scientific events which led towards five major technological innovations. The data collected were carefully analyzed. This study produced findings which not only substantiated some intuitively accepted beliefs but which also yielded some interesting points that shed new light on the very involved process which leads from research to innovation.

1. In all cases studied, nonmission research provided the origins from which science and technology could advance toward the innovations which lay ahead.
2. Of the key events documented, approximately 70 percent were nonmission research, 20 percent mission-oriented research, and 10 percent development and application.

3. The distribution by performers of key events was as follows:

| | University | Res. Inst. | |
|-----------------------------|----------------|--------------------|-----------------|
| | <u>College</u> | <u>Gov't Labs.</u> | <u>Industry</u> |
| Nonmission research | 76% | 14% | 10% |
| Mission-oriented research | 31 | 15 | 54 |
| Development and Application | 7 | 10 | 83 |

4. The number of nonmission events peaks significantly between the 20th and 30th year prior to an innovation, while mission-oriented research events and those in the development and application area peak during the decade preceding innovation.
5. For the cases studied the average time from the conception to demonstration of an innovation was nine years.
6. Ten years prior to an innovation; i.e., shortly before conception, approximately 90 percent of the nonmission research has been accomplished; in so far as one can generalize from the results of this study, most nonmission research is completed prior to the conception of the innovation to which it will ultimately contribute.
7. Although nonmission and mission-oriented activities regress during the several years just preceding innovation, it is apparent that the interplay between these types of research activities is important and some-

times even crucial during this terminal period.

8. The presence of interdisciplinary communication is very evident in, and important to, the achievement of innovation.
9. The role of U.S. research has continued to increase relative to foreign contributions. However, foreign research continues to be important to innovation.
10. The study points out the need for a better understanding concerning the two-way interaction between science and technology. The tracings revealed cases in which mission-oriented research or development efforts elicited later nonmission research which often was found to be crucial to the ultimate innovation.
11. Innovations for the next generations depend on today's nonmission research.

These studies clearly indicate that university research played a very important role not only in the "origins" (basic research) leading to innovations but also in the mission-oriented research involved. Industry, on the other hand, played a minor role in basic research but a major role in mission-oriented research and a clearly dominant role in development and application. This, we believe, is exactly as it should be. Canada is now producing effectively in the fields of basic research but obviously very poorly in development and application leading to innovation. It is in industry that these aspects of research must be made much more effective.

We suggest that the Senate Committee might well study the capabilities of Canadian industry to act upon the results of basic and applied research. No science policy will be really effective unless Canada has the industrial capability and risk capital to carry research results through to innovation when this is justified.

Many of the submissions made to our university committee stressed the undesirability of drawing a sharp line between basic and applied research. Many university departments, particularly in the fields of agriculture, engineering and medicine are engaged in research aimed at solving specific problems. This is certainly also true in the social sciences and we shall return to some of the consequences and problems which result from this. Basic research may often have an obvious and immediate application while mission-oriented research must often,

of necessity, be very basic in character. Members of our Faculty supplied the committee with many examples, only a few of which can be referred to.

1. The basic research of Cohn and Edsall and their associates at Harvard led to the successful fractionation of the blood plasma proteins. The fractionation schemes developed from fundamental studies on the solubility and structure of the amino acids, peptides and proteins, and the application of purely fundamental methods for separation and purification. In retrospect, this work looks almost like applied research, so quickly were the results translated into practical application. Out of this basic research came vast quantities of serum albumin for the treatment of patients in shock; of γ -globulins for patients requiring immunization against certain diseases; of fibrin foam and film for use in neurosurgery; of isoagglutinins for blood typing; and of knowledge of the detailed nature of the α and β lipoproteins and their roles in diseased states such as atherosclerosis.

2. The basic research of Enders at Harvard showed that monkey kidney cells, grown in culture, are capable of supporting the replication of poliomyelitis virus. Provided with this crucial information - and the system in which to produce vast quantities of virus - Dr. Salk and the Polio Foundation were able, in a very short time, to produce the first effective vaccine against this dread disease.

3. The present generation of computers must certainly be classified as an example of technology utilizing the results of curiosity-based research into the properties of the solid state. It is the use of the transistor which is one of the major advances in computer technology.

Earlier it was stated that the more applied faculties at the university carry on considerable applied research and scientists in these faculties all caution against drawing a sharp distinction among types of research.

The Faculty of Agriculture is directly concerned with the production and distribution of food at the international level as well as with the very important contribution of food and other farm products to national prosperity. Certainly these concerns fit into the goals cited by the Science Council of Canada as a framework for future policy. The departments in this Faculty believe that their major contribution is, and will continue to be, in the form of basic research into the fundamental laws which govern the production of foodstuffs for human consumption. Nevertheless, the capacity of the individual or small groups

of individuals to solve the problems facing agriculture will diminish. They therefore believe that individual research should be complemented by the development of multi-discipline projects. The university researchers should work together with government and industry on such projects. To some extent this is already being done, but continuous financing is not definitely and adequately provided. Agricultural scientists believe that graduate students can be effectively and efficiently educated in such a research environment.

The position taken by the academic staff in our Faculty of Engineering is somewhat different. The concluding statements of their submission are as follows:

"I trust these comments will leave no doubt in the minds of the committee that we give our wholehearted support to the essential philosophy expressed in the E.I.C. report and the Science Council Report No. 4. We favor an increased percentage of the Gross National Product in Canada being spent on research and development and we believe that a far greater percentage of this money should be directed toward applied research and development. We agree with the general principle that the research effort in Canada must be concentrated on certain priority areas or mission-oriented projects which are of prime importance to the country, and we favor a relocation of much of the research activity currently undertaken by Government laboratories.

The final point I would like to make concerns semantics. We should be very clear what we mean when we are discussing the merits of basic research versus applied research. Basic research as used in this report is that it is a generalized search for new knowledge without application in mind whereas applied research is the search for new knowledge to provide a solution to a specific problem which is defined at the outset of the research program. It does not differ radically from basic research in methods or scope, but in motivation. Much of the work required for applied research or development is very "basic" and very "fundamental".

They also state:

"Greater funding and greater emphasis should be placed on applied research and development in graduate schools and in particular in the Professional Faculties at Canadian Universities."

While part of the differences presented by various groups is due to differences in the use of terms, it is clear that the engineers wish to see more drastic shifts in the use of research funds than do many other groups. It is probably natural that the scientists in basic physical science fields do not entirely agree with the emphasis that the engineers put on the need to direct the research funds available in Canada to support a limited number of massive projects which, if successful, appear to the Science Council to have the best chance of bringing about improvement in our socio-economic position. The physical

scientist must protest that no one can say what basic research projects will be most important to the innovations of tomorrow, and therefore creative scientists must be allowed to carry out research in their own fields. (See Douglas, Science Forum (6).)

The medical scientists stress the need for major increases in research funds for the health sciences. Canada's position in medical research has recently been reviewed by 16 assessment groups under the auspices of the Medical Research Council (M.R.C.). The findings were published in two volumes in 1968(7). The major recommendations call for enormous increases in financial support, in the numbers of competent research workers, and in research space. Again, there can be no clear classification of research projects into basic and applied and the rapid utilization of basic research results in medical applications has already been stressed.

The biological sciences are intimately associated with developments in such areas as agriculture and medicine. A particular project might be called basic or applied simply on the basis of the description. Thus, one investigator said that his own basic research could be described either as, "The study of the morphology and physiology of chloroplasts and photosynthesis", or alternatively as, "The study of biochemical processes which use the sun's energy to produce the world's food." What more important potential application could there be?

Biologists are also very much concerned with fisheries, wildlife and the management of renewable resources. University biologists, in carrying out their responsibilities for training professional scientists are in a position to supply and direct the manpower required for mission-oriented research in ecology and resource management. Expenditures for research in such situations also become expenditures for education.

Canada has lost many of its most outstanding biological scientists to the United States because there was no adequate source of support to meet the offers made to these high quality scientists by American institutions. Our biologists are convinced that biological research has a most important role to play in improving our socio-economic position and that science policy must make adequate provision for its support,

There is a general feeling that specialists in the social sciences are working by themselves too much and that departmental organization must be modi-

fied if fruitful interdisciplinary research is to be done. It is also agreed that more funds are needed for all types of social science research.

Mission-oriented research projects in the social sciences will utilize the abilities of many specialists in different disciplines. Such projects, however, are almost certain to disturb different groups and individuals in society and very quickly run into resistance. Any recommendation to change our society draws fire from some quarter and the chances are that the more the recommendations aim at fundamental change, the greater the opposition from traditional or conventional social and political forces. For example the Hall Commission on health services used the services of many people in the social sciences, who carried out massive research studies. One of the recommendations, the provision of universal medical care for all Canadians, has met bitter opposition.

Industrialism (i.e. science and technology) has provided mankind with means undreamed of one or two generations ago. The process of material economic growth will go on so long as we make sure that a rising proportion of scientists, technologists and administrators is produced by our society. It remains for the social sciences to work hard on modifying social institutions to adapt them to the ever-changing environment and shifting power structures. The world of today is a better place in which to live than it was 60 years ago, and there is tremendous potential for a much better world in the future.

Education has a very important role to play in bringing about changes in our social structures. It is, in fact, a social science of greatest importance. Policies in Canada have resulted in very little support for research into elementary and secondary education. Research in these areas is just as important as in any other and a science policy that neglects this area will neglect one of the most important channels for educating people to accept and contribute to the social changes that will be required.

Many successful commercial companies have developed research organizations that recognize the importance of all levels of research and provide adequately for each. Such a company as I.B.M. has such a research organization and no one can question its success as a profitable company. We suggest that the Senate Committee might well study some of the models of research and development used by companies now operating and competing most successfully in highly competitive technical markets.

Rudd (4) was quoted by Senator Lang as stating: "The purchase of know-how by a firm or a country can play a more important part in technological advance than the firm's or country's own research and development." This is certainly true if there is no really first-rate research going on in a country but this is not the case with Canada. Carried to its logical extreme, this policy would result in no one carrying on research or development and innovation and new production would quickly grind to a standstill. We therefore reject this idea as applied to Canada. On the contrary, we believe that to a considerable extent, innovation will be directly related to Canadian research results if our science policy provides adequately for the carrying of our best research results through from basic ideas to conception and application in production. We will, of course, use imported ideas, but to depend exclusively on them is to settle for mediocrity, and economic domination by other countries.

There are two further very important reasons why Canada cannot rely on imported know-how and technology. They have been mentioned by scientists in nearly all disciplines.

First, a nation cannot even use imported know-how unless it has a sufficient number of highly trained specialists. This is particularly true in some disciplines; e.g., Medicine. One example will illustrate this. The benefits of the artificial kidney cannot be made available in every hospital simply by buying the necessary machines. The application of this highly advanced form of treatment requires the presence of a specialized team and, at present, such teams are found only in those centers doing research in the field.

Second, our universities simply cannot recruit staff to discharge our teaching responsibilities if, as the Medical Research Council Report (7) says, "they are to be merely purveyors of knowledge rather than contributors to knowledge." Universities cannot provide the facilities necessary for education beyond the first degree unless they have access to large amounts of money for research. But they cannot be permitted to fail in the education of highly qualified scientists and scholars because continued advance in Canada depends to a great extent on these people. If, as we stated earlier, a steadily rising proportion of scientists, technologists and administrators is required to assure Canada's future, then our universities have a most important role to play in the successful application of any science policy that may be developed for Canada.

The University of Alberta has established and developed extensive research facilities in many disciplines. This development has been greatly helped by the provision of federal funds, but it must be recognized that the Province of Alberta has contributed large sums to provide buildings and to staff the departments with highly competent scientists. These resources must be effectively used and we believe that our university can continue to make substantial contributions to the scientific development of Canada.

We conclude by repeating that, in the best interests of Canada, individual scientific creativity should be used to its fullest and this means that there must be adequate support for curiosity-based research by our creative scientists. A science policy for Canada that would concentrate the research resources exclusively on a limited number of mission-oriented projects selected by government or government councils could easily discourage or destroy much of the scientific creativity - or else drive it from the country. Universities can contribute much to mission-oriented research but our research responsibilities demand that we have the resources to discharge the unique responsibility we have for the education of those who will carry on research in the future.

Respectfully submitted,

- J. S. Colter - Professor and Chairman,
Department of Biochemistry
- H. E. Gunning - Killam Professor and
Chairman, Department of Chemistry
- E. J. Hanson, Professor of Economics
- S. M. Hunka, Professor of Educational
Psychology and Director of
Educational Research
- A. G. McCalla, Professor of Plant Bio-
chemistry and Dean, Faculty of
Graduate Studies
- F. V. MacHardy, Professor of Agricultural
Engineering and Dean, Faculty of
Agriculture
- D. M. Ross, Professor of Zoology and Dean,
Faculty of Science

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APPENDIX 87

BRIEF
SUBMITTED TO
THE SENATE SPECIAL COMMITTEE
ON
SCIENCE POLICY
BY
DEPARTMENT OF GEOLOGICAL SCIENCES
UNIVERSITY OF SASKATCHEWAN
REGINA CAMPUS

24 February, 1969.

1. Rapid Communication of Information

A deficiency in the structure of science in Canada is the poor means of communication of information whose significance may be short-lived. In this respect, Canadian science tends to be an appendage of U.S. science which has available to it a variety of means of rapid dispersal of scientific ephemera.

General scientific journals such as "Science", discipline-oriented journals such as "Geotimes", a variety of newsletters, and the many regional meetings of national scientific societies in the United States provide the means for rapid spread of information. Such things as personnel appointments, grants in aid of research, new publications, reviews of growth points in science, comments on science by government and political leaders, job vacancies, and announcements of conferences are quickly made known to scientists across the United States and in other countries. It is, therefore, considerably easier for Canadian scientists to know of the needs and pressures of science in the United States than of the same things in their own country. Canadian institutions to some extent communicate to each other and to the world via American media.

On the one hand, the open-ness of science in the United States and the availability of its communications systems to Canada is an undoubted benefit. But, on the other hand, it does seem that a national science policy for Canada should include a better and more rapid means of information

dispersal than exists at present.

2. Research Emphasis

Without going into specifics of particular disciplines of science, it seems possible only to re-state certain truisms which the development of science in Canada already is taking into account.

Canada should maintain a broad spectrum of scientific research and development while at the same time emphasizing areas which are of peculiar interest to the Canadian situation. The northern geographical position, climate, size, available wealth, and degree of development of Canada indicate what those areas of particular interest should be. Canada has developed, and should continue to develop, points of excellence in fields for which this country either has unique opportunities or unique needs. These include northern hemisphere upper atmosphere studies, long distance data transmission, long distance transportation (including arctic transportation), natural resource development and its relationship to environmental spoilage, and arctic studies of all kinds.

3. Science Education

Because of the Federal-Provincial constitutional relationship, science education presents a difficult problem. Nevertheless, a national science policy should take into account all levels of schooling.

a) Public Attitude Towards Science

The attitude of even the intelligent layman towards science is all too often one of disinterest, if not of antipathy. Science and its technology have been fundamental in the creation of Canadian and world society. It seems most fortunate that what have been, on the whole, benign influences should not have attracted a better feeling from the ordinary man who is usually more conversant with history or literature than with any aspect of sciences. Presumably, grade school and high school education is not being effective in transmitting to students a proper understanding of science as a great formative influence in the world in which they live. Certainly, many young people arrive at university with an open hostility to science.

b) Sub-university Education

In light of the foregoing, it seems that greater national or regional efforts should be made to expand and improve science teaching in school from kindergarten upwards. Although the constitutional position is different in the United States, it is worth noting the success which the American National Science

Foundation has had in upgrading science teaching below the university level. A national science policy must surely lose much of its effectiveness if it is directed only at the highest levels of education and at research and development.

c) Universities

Federal, provincial, other governmental, and non-government support for university education and research is an accepted commonplace. It needs little comment except perhaps to note that more consideration might be given to support of undergraduate science in the earlier university years. Here again, the National Science Foundation in the United States has worked most effectively to finance a variety of projects including teaching aids, refresher courses for university teachers, re-equipping out-dated teaching laboratories, and high school teacher training courses. Canada could, perhaps, learn from this experience.

W.A.Gordon
Associate Professor
of Geology

WAG:de

APPENDIX 88

BRIEF

SUBMITTED TO

THE SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

BY

FACULTY OF ADMINISTRATION

UNIVERSITY OF SASKATCHEWAN

REGINA CAMPUS

February 25, 1969

FROM: Robert E. C. Wagner
Faculty of Administration

February 25, 1969

TO: Dr. A. B. Van Cleave

RE: Faculty of Administration Submission to the Special
Committee on Science Policy of the Senate of Canada

In this discussion, the general framework indicated by Senator Lamontagne in his letter of December 20, 1968 to Principal Riddell will be followed:

- A. Recent trends in research and development expenditures in Canada as compared with those in other industrialized countries.

The simple but startling facts are that whereas the United States spends approximately \$112 per capital on research and development, Canada's outlay is only \$37 per capita. These figures are for the latest year available (1967) with total expenditures amounting to \$22.3 billion for the U.S. and \$770 million for Canada.

"A recent study shows Canada ninth of nine leading western industrial nations in percentage of R & D performed by industry about 45% compared with 70% in the U.S. Moreover, Canada ranks eighth in percentage of GNP allotted to R & D ..."² Canada allocates 1.19% of GNP to R & D whereas in the U.S. it is 3%.³

This gap, unless Canada makes a remarkable turnabout, is likely to get worse instead of better. All indications are that the new Nixon Administration is going to increase emphasis on R & D.^{4, 5} Lee DuBridge, Nixon's science advisor, says that every possible measure

¹ "Canada asks Industry into the lab", Business Week, December 28, 1968. pp.84-86.

² Ibid., p.85.

³ Ibid

⁴ "Plugging the gap in R & D grants to universities", Business Week February 15, 1969, p.63.

⁵ "Science agency gets more funds", The New York Times, February 6, 1969 p.27.

is being taken to restore the cuts made by President John last year⁶.

It is instructive to note that many in the Canadian science community feel that the situation with regard to federal funding of R & D is getting worse not better.^{7,8}

- B. Research and development activities carried out by the Federal government in the fields of physical, life, and human sciences.

The Canadian government supports R & D in the amount of \$255 million whereas the U.S. government spends \$14.93 billion - once again the U.S. is proportionately ahead of Canada on this account by a ratio of almost 6:1.⁹

It is worthy of note that the Canadian government does approximately 35% of the R & D whereas the U.S. government does only about 14% of the total R & D engaged in. Questions as to policy and organizational efficiency are obviously involved - the U.S. thinks that industry and the universities are better suited for the actual R & D than the government.¹⁰

"The support given to research in the social sciences in Canada has been totally inadequate. It represents only a small fraction of the support for natural sciences; it is smaller in relation to population and total income in Canada than in the United States."

⁶ "DuBridge to Seek Closer Ties of Government with Scientists", The New York Times, December 17, 1968, p. 30.

⁷ "The gloomy picture painted by Canada's scientists", The Globe and Mail, September 28, 1968.

⁸ "Canada has no science policy", The Leader Post (Regina), February 7, 1969, p. 18.

⁹ Business Week, December 28, 1968, op cit. This proportionate ratio, like all others in this paper, is determined by using a 10:1 adjustment for the population difference between the two countries; i.e., with regard to this example, the absolute ratio is close to 60:1 whereas the ratio adjusted for the population difference is 6:1.

¹⁰

ibid.

and various other modern societies."^{11,12} Since Clark Kerr says that only about 10% of government support to academic institutions for research goes to the social sciences¹³ (and the government supports academic research with about \$1.5 billion) by extrapolation this means that less than \$15 million must be available for such research in Canada.

- C. Federal assistance to research and development activities carried out by individuals, universities, industry and other groups.

The following figure should prove enlightening. In 1965, the Canadian government supported research in the universities in the amount of \$57 million¹⁴. In the United States, the federal government for the current fiscal year has allocated \$1.519 billion to academic research.¹⁵ Taking into account the population differences, this still results in a ratio of federal support to academic research favoring the U.S. condition by almost 3:1. In this connection it is worthy of note that the total amount spent on academic research (in the United States) from all sources for the year ending December 31, 1967 exceeded \$3.0 billion dollars".

¹¹Fifth Annual Review of the Economic Council of Canada: The Challenge of Growth and Change. September, 1968, Queen's Printer, Ottawa, p.53

¹²See also The Social Sciences in Canada by the Social Science Research Council, May 1968, Ottawa.

¹³Clark Kerr, "New Challenge to the College and University" in Kermit Gordon (ed.) Agenda for the Nation. The Brookings Institution, Washington, D.C., 1968, pp.237-276.

¹⁴Fifth Annual Review, op cit.

¹⁵"Federal Budget", The New York Times, January 16, 1969, p.24.

¹⁶Business Week, December 28, 1968, op cit.

Federal support for university research in the United States has been growing at a 15% rate compounded since 1953.¹⁷ Although it is unrealistic to think that this rate can be maintained indefinitely, such scholars as Clark Kerr,¹⁸ Donald Horning¹⁹ (Johnson's science advisor), and Harvey Brooks²⁰ (Dean, Division of Engineering and Applied Physics, Harvard University), think it should be the goal of the government for the foreseeable future. Dr. DuBridge is not sure whether the 15% rate of increase can be maintained but is certain that the increase will not fall below 10%.²¹ A 15% rate of increase would double current R & D in less than five years.

What is Canada doing to match this level of increase?

- D. The broad principles, the long-term financial requirements, and the structural organization of a dynamic and efficient science policy for Canada.

The import of the parts A, B and C appears quite obvious to the Faculty of Administration. More money must be generated in the area of R & D in general and in academic research in particular. To quote again from the Fifth Annual Review of the Economic Council of Canada, "in our view, no task may be more important to improving Canada's innovative performance than to strengthen the capabilities of Canadian management to understand and manage technological change and its innovative process. There are many routes to this end. One of the most rewarding is likely to be improvement in management education and training . . . Along with this there should be an expansion of university based business research, as well as attention to improved systems of management development in Canadian corporations, governments and institutions."^{22,23}

¹⁷"Scientists on campus flunk in federal aid", Business Week January 4, 1969, pp. 86-89

¹⁸ Clark Kerr, op cit.

¹⁹ Business Week, January 4, 1969, op cit.

²⁰

Harvey Brooks, "The Future Growth of Academic Research: Criteria and Needs" in Harold Orians (ed.) Science Policy and the University. The Brookings Institution, Washington, D.C., 1968, pp. 53-87.

²¹ The New York Times, December 17, 1968, op cit.

²² Fifth Annual Review, op cit., pp. 54.

²³

See also The Professional School and World Affairs. The University of New Mexico Press, 1968. This study emphasizes the need for education in the professions and indicates that we have been woefully neglectful in this area--particularly as it relates to world affairs.

Several of our faculty have been thwarted and frustrated in their attempts to secure funds for study in the areas of public, business, and health administration. The sparse amounts of money available from either internal or private research funds limits these as truly meaningful sources of assistance for long-range research projects.²⁴

It is meaningful to note that the one institution in Canada which has gained a national reputation for innovative research in the area of administration and the development of graduate programs in fields other than business is York University . . . whose main financing has come through a grant of \$500,000 from the Ford Foundation in New York City !!!²⁵ "interesting . . .

As far as management education is concerned, the latest figures available (for 1967-68 academic year) indicate that there were 16,354 MBA (or equivalent) degrees and 490 Ph.D. degrees granted from universities in the United States as compared to 341 MBA degrees and only one Ph.D. degree in Canada.²⁶ The ratio again favors the U.S. by 5:1 for MBA's with the Ph.D comparison meaningless.

²⁴The Principal's Research Fund on the University of Saskatchewan Regina Campus amounts to \$10,000 per year; the Banff School of Advanced Management Research Fund amounts to only \$10,000 in total; The Bronfman Research Fund also only had \$10,000 available and The Institute of Public Administration of Canada's Research Fund amounts to \$20,000.

²⁵"The closed loop", The MBA, January, 1969, p. 25.

²⁶The MBA January, op cit.

One of our faculty members whose area of research is in manpower, labor and industrial relations indicates that he feels that Canada is at least two decades behind the U.S. in both the quantity and quality of research undertaken.

The goals of a science policy have been discussed and deliberated at great length on both sides of the border. Some excellent books are available summarizing these discussions.²⁷ As both the Economic Council Report and the Social Science Report indicate, one of the major problems of Canadian effort in this area is lack of coordination and communication as to what has, is, or might happen. As a result of this, it is highly recommended that the conclusions and recommendations of both these reports be studied carefully.^{28,29,30} The rediscovery of the same problems and potential solutions by various sectors in our society, due to inefficient or non-existent communication, is one of the most deplorable wastes of manpower imaginable.

Those who fear the advance of science and technology because of its effect on the human quality of mankind should be reassured by the preliminary results just released of a study by a group of Harvard University scholars. According to this group, modern technology, rather than dehumanizing the populace, has made western civilized man the most genuinely individual in all history.³¹

²⁷ See Agenda for the Nation; Science Policy and the University referred to above. The following books are also useful in this regard: Applied Science and Technological Progress: A report to the Committee on Science and Astronautics by the National Academy of Sciences, Government Printing Office, Washington, D.C., 1967; William R. Nelson: The Politics of Science, Oxford University Press, 1968; L.V. Bernner, The Scientific Age, Yale University Press, 1964; Van Tessel and Hall (eds.): Science and Society in the U.S., The Dorsey Press, 1966; Frederick Seitz: Science, Government and the Universities, University of Washington Press, 1966; Boyd R. Keenan (ed.) Science and the University, Columbia University Press, 1966.

²⁸ Fifth Annual Review, op cit. pp.29-61.

²⁹ The Social Sciences in Canada, op cit.

³⁰ Also see Applied Science and Technological Progress above

³¹ "Study terms technology a boon to individualism", The New York Times, January 18, 1969, p. 1 F.

APPENDIX 89

BRIEF SUBMITTED BY

J.W.T.SPINKS,

PRESIDENT,

UNIVERSITY OF SASKATCHEWAN

TO THE

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

February, 1969.

Introduction

About a hundred years ago Newman expressed the ideal of the university as that of being a repository of knowledge and ancient wisdom and stated that the university fulfilled its duty if it kept this wisdom alive and handed it on from generation to generation. He thought that research was better done in academies and institutions and that, in fact, a good teacher was unlikely to have time to do research. However, universities, like other institutions, are subject to change, and nowadays the universities have as one of their major aims the extension of the boundaries of knowledge. It has even been said that for a modern university to stop doing research is to commit academic suicide. Similarly, in choosing senior staff one usually looks for the productive person, on the grounds that if, say, the head of a department is well known for his research he will be able to attract to him lively young men, and between them, the burden of teaching can be very well taken care of. One of the main objectives in teaching at the university level is to inspire the student to work and think for himself. Who can do this better than the man who is still actively contributing to the production of new knowledge? The nightmare of a president is to have unproductive heads of departments, for it soon becomes evident that, with an unproductive head, the whole department loses its interest in furthering knowledge, too. Universities have proved, for their part, to be ideal places for doing fundamental research; they provide time to think, an opportunity to work and talk with keen minds in other disciplines, the stimulus of contact with bright students, the lack of being prodded to some close and fixed goal.

An important development in the last decade has been the demonstrated capacity of the modern university to tackle problems in 'big science' as well as 'little science'. A much to be hoped for development would be a greater involve-

ment in 'big social science' experiments as well as 'little social science' experiments.

Graduate Studies and Research in a Modern University

One of the dominant features of the modern university is the graduate school and the conscious search for excellence. Graduate studies are now so well accepted in the modern university that the writers of a recent report on graduate studies felt that they could start one chapter with the following sentence: "The Committee began its work on the assumption that graduate studies need no justification," and it is likely that no one would care to challenge this assumption. However, between agreeing generally with this assumption and agreeing to provide the rather staggering sums required for present-day graduate work and research at the universities, there may still be a rather large gap. Closing the gap by the provision of adequate funds is, in a sense, a political decision, since funds used for this purpose are not available for roads, social welfare and other desirable public ends. It is to help justify the closing of this gap that some further comment is presented on the paramount importance of graduate work and research to the provincial and national economy.

The first point to make is that not only is good research done by the universities, but a number of autonomous or semi-autonomous research groups have also found it profitable to establish themselves on university campuses.

There is now at the university an increased emphasis on graduate work and research; an increased emphasis on training people to take their place in research organizations, not only in the basic sciences, such as physics and chemistry, but also in medicine, economics, engineering and education; an increased emphasis on research for its own sake; an increased emphasis on excellence. All this is in keeping with the spirit of the new age -- an age characterized by change, an age characterized by towering intellectual achievement. Our young people must be brought up to be aware of the fact that we have much yet to learn and that, in

science at least, the only place from which to begin probing into the unknown is in the borderland of knowledge. In words attributed to Ashby:

"Universities are traditionally places where research is to be found ...but...this is a very minor reason for requiring university teachers to advance knowledge. The main and compelling reason is that they cannot do the sort of teaching which is required of them unless they are advancing knowledge. Advanced work has to be done in the front line of scholarship. A student has to be led up to the 'no-man's land' between what is known and what is unknown. Now, the only kind of teacher who can be trusted to lead students to the frontier between the known and the unknown is a man who himself spends many of his thinking hours at that frontier. Only at the frontiers can man discern the anatomy of scholarship."

These same students must also be made aware that the world belongs to those who achieve -- not only in the launching of satellites, where a superior thrust due to a superior chemical puts the heavier satellite into orbit, but also in business, where the corporation with the best research group comes up with the most revolutionary ideas, whether it be in artificial fibres, such as arnel, or in the latest type of jet aircraft.

The Knowledge Industry

Earlier, many of our best young men and women went elsewhere for graduate work, and no one was very happy about this. Obviously, some of the best graduates should be encouraged to go abroad to enrich their educational experience, but to allow this to become a general practice with ever-growing numbers, would mean that Canada was neglecting its responsibilities in the field of higher education. Progressively the country would lose many of its best brains and in the process lose its creativeness and independence.

Acceptance of this point of view has resulted in the growth of graduate studies and a much greater emphasis on research, both for its own sake and as an essential concomitant to teaching, in Canadian universities.

Kerr has summarized the matter very neatly:

"The basic reality for the university is the widespread recognition that new knowledge is the most important factor in economic and social

growth. We are just now perceiving that the universities' invisible product, knowledge, may be the most powerful single element in our culture, affecting the rise and fall of professions, and even of social classes, of regions and even of nations...it has been estimated that over the last thirty years, nearly half of the national growth (of the USA) can be explained by the greater education of our people and by better technology, which is also largely a product of the educational system.

What railroads did for the second half of the last century and the automobile did for the first half of this century, may be done for the second half of this century by the knowledge industry; that is, to serve as the focal point for national growth. And the University is at the centre of the knowledge process.

The new connection of the university with the rise and fall of industrial areas has brought about an inter-university and inter-regional competition unmatched in history except by the universities and their Lander in 19th century Germany. Texas and Pittsburgh seek to imitate what California and Boston have known; so do also Iowa, Seattle and nearly all the rest. A vast campaign is on to see that the university center of each industrial complex shall not be 'second best'."

Similar points are made by the Economic Council of Canada, in Towards Sustained and Balanced Economic Growth and in the report put out by the Organization for Economic Co-operation and Development, The Residual Factor and Economic Growth. The importance of research in stimulating economic growth now seems so well accepted that in the United States at least, the doctrine is being advanced that for the well-being of the nation, centres of excellence should be somewhat more widely dispersed.

Quoting from a White House document, Strengthening the Academic Capability for Science Throughout the Nation:

"Lyndon Johnson and his scientific and educational advisors have decided that basic research has too much impact on the university environment and surrounding geographic regions to permit it to be governed mainly in terms of the desires of its most successful practitioners.

Heretofore, money for university researchers was allocated with fairly strict adherence to the concept that science could be treated as an island in the academic setting. For the first 15 or so years of the postwar period, this concept was scientifically and politically useful, since a Congress that was skittish about supporting education could be told that, in the interest of defence, public health, and other nationally accepted goals, the money was being used to buy nothing but science and that only the best science was being bought. Eventually, however, it became painfully clear that science could not enjoy unique prosperity without affecting other parts of the academic setting, and further, that the

"concentration of scientific capability at a relatively few universities was somehow related to regional economic prosperity."

In summary, then, graduate studies and research play a vital role in the proper development of this country and each province. Every effort must be made to ensure that they develop rationally and receive adequate support.

Research - National and Provincial

The national aspects of research have been dealt with at length in numerous other briefs. Only matters relating to universities and the provinces will be dealt with here.

Coordination of Federal-University Research Interests

The interest of the Federal Government in fostering research in graduate studies in the universities during the last half century is too well known and too well accepted to require further elaboration at this time. The universities are most grateful for the assistance given by the NRC, MRC and many government departments and agencies. They would not wish this assistance to be in any way diminished -- in fact, they would like it to be very much increased. However, it should be pointed out that every dollar of research support received from outside the university usually implies the commitment of at least one dollar, in one way or another, from inside the university. The support is given to a large number of individuals, largely as a result of a policy of supporting excellence in individuals. This policy was all right when the numbers of people and amounts of money were small, but once the numbers of people become large and the amounts of money an appreciable proportion of the university budget a more conscious attempt to co-ordinate this method of support with the long range plans of the institution becomes imperative.

Thus greatly increased federal research support, both operational and capital, is required. In addition, the method of giving this support to ensure

that it is used in the best interests of the recipient institution and the province in which the institution is established, needs a thorough re-examination.

Federal-Provincial Liaison

While the Federal Government has exhibited a lively concern for science and technology for the last century it is only within the last two or three decades that the provinces have started to show a corresponding interest. Most of the provinces now have a Provincial Research Council and there are the first stirrings of interprovincial coordination through informal meetings of Directors of Research Councils and through the setting up of such bodies as the Canadian Council of Resource Ministers. The Federal Government is gradually developing a policy with respect to science, as is evidenced by the recent establishment of the Science Council. However, even here the Federal Government has a long way to go before it has a reasonably well defined science policy. Here again we lag behind the USA which has long since recognized the powerful centralizing effects that modern science policy can exert. The President has well established mechanisms for receiving top level scientific advice and there are well established methods for raising the level of scientific competence of less developed parts of the country. A number of the provinces are now defining provincial policies with respect to science but it would probably be fair to say that provincial policies with respect to science are still in the formative stage. The role of the provincial research effort in the overall national research effort is still far from clear and to date no very obvious steps have been taken to integrate or coordinate provincial research plans with the Federal Government's grand design for science and technology. In a country the size of Canada more and not less coordination of effort is clearly indicated if Canada is to find its proper place in a world dominated by highly sophisticated technologies. Collective autonomy should be the slogan. Quite apart from the obvious economies to be achieved in areas such as library services and

scientific information retrieval it is only by making an optimum use of all its resources that Canada will be able to develop its full potential. It is strongly recommended that the Federal Government take immediate steps to strengthen its science policy making machinery and at the same time assume a leadership role in promoting a more effective coordination of the scientific efforts of the Provinces.

Health Sciences Research

Much of what has been said about science generally could be applied equally to the Health Sciences. The advent of medicare is rapidly forcing the provinces into a systems approach to their health-care systems and makes them more easily able to adapt themselves to long-range federal plans.

Planning with respect to research and the execution of those plans would be helped by the early establishment of a Medical Research Council or a Health Science Research Council, reporting directly to a Minister of the Crown. The MRC might be expected to assume the responsibility for meeting national needs in health science research by supporting research in universities, other institutes and government laboratories. The importance of systems analysis or 'operations research' with respect to the optimum development of health care systems cannot be over-emphasized.

Social Sciences and the Humanities

Needless to say, all that has been said about science needs to be said still more strongly for the Social Sciences, the Arts and the Humanities, where even the bare resources are often pitifully inadequate, e.g. with respect to libraries, art galleries, concert halls, theatres, museums, etc., etc., and so forth! The start made in the 100th anniversary year to rectify some of these inadequacies needs to be strongly reinforced, and, here again, the Federal Government has a strong leadership role to play. It is strongly recommended that the Federal Government take immediate steps to strengthen its policy making

machinery with respect to the Arts, Social Sciences and the Humanities and at the same time assume a leadership role in promoting a more effective coordination of activities in the humanistic and cultural activities of the Provinces.

Regional Disparities.

There exist many examples of regional disparities in Canada. The northern half of the Province of Saskatchewan shows an accentuated regional disparity with respect to other parts of the country. An especial all out effort should be made to remove this disparity. The Federal Government, as establisher of the original boundary lines, has a clear responsibility in this area. It has been suggested that in line with the concept of organization for development, one or more regional Research and Development Institutes, charged with the specific task of accelerating the economic development of the region, might be set up. As they developed new industries or gainful occupations, the institutes might take on a teaching and training role.

What all this boils down to is this -- deeds not words are required -- deeds of a federalistic kind where the whole assumes some degree of responsibility for the wholesome development of its parts. The deeds take place as a result of well developed long range plans respecting the future of our country -- their implementation requires men and materials -- in other words -- a proper apportionment of resources, not a series of handouts to suppliant or clamorous beggars.

Coordination of Research Efforts - Intraprovincial

(a) General

Each of the provinces now does a considerable amount of research - partly within the universities, partly in industrial laboratories and research institutes, partly in provincial government laboratories. There does not seem,

however, to be any conscious effort on the part of anyone to ascertain what the total research effort of a given province is, or the degree to which the total research effort meets the particular needs of the province. What is needed in most cases is a provincial policy with respect to research. It is of interest that the N.S.F. has recently provided a substantial grant for a pilot State Science Policy Study for the State of Tennessee. A similar study for one of the provinces in Canada would be well worth while.

(b) Interuniversity

The coordination of research efforts in the sense of fitting in with the provincial needs and also of avoiding wasteful duplication of effort requires some form of interuniversity coordination.

Coordination of Provincial Multiple University Systems

The problem posed by the support of several institutions from the same public fund is certainly not a new one. Most of the Provinces of Canada have more than one institution of higher education receiving state support. All but two states in the United States have several, and some have literally dozens of institutions supported from the common purse. In Great Britain all the universities derive the major portion of their funds through the University Grants Committee.

Various patterns of governance have been developed for the coordination of such multiple university systems, each involving a certain minimal loss of autonomy. In return the constituent universities receive assurance that their basic programmes will be supported and that their more specialized or esoteric fields of study will be protected from competition; that capital grants will be made on the basis of inter-institutional agreements and that operating funds will be justly allocated.

The coordination of university research efforts within a province will be greatly influenced by the pattern of overall governance of the multiple university system. Broadly speaking, there are two main patterns; in the one, the universities coordinate their efforts in a voluntary system under a University Affairs Committee or Commission; in the other, there is a Provincial University to which all the university campuses in the province belong. This subject is pursued further in Appendix A.

Coordination of Graduate Studies and Research

(a) Intraprovincial

Coordination of graduate studies and research is in principle particularly simple using the one-university approach. Each campus has a College of Graduate Studies to foster and supervise graduate work at the campus level. There is, in addition, a University College of Graduate Studies which supervises work at the Ph.D. level for the whole University. The Dean of the University College is also Vice-President (Research) for the University and advises the Board on large research contracts. By comparison, promoting the advancement of graduate studies and research in the Ontario universities is undertaken by the Ontario Council on Graduate Studies, an affiliate of the Committee of Presidents of Universities of Ontario. The Committee of Presidents was formed in 1962 and relates to the Committee on University Affairs but does not, as far as can be ascertained, have any statutory status or authority. It is placing its faith quite firmly in a voluntary university system but is becoming increasingly aware of the necessity of 'collective autonomy'.

(b) Interprovincial

Coordination of higher educational activities has only just started at the interprovincial level through agencies such as the Association of Universities of the Atlantic Provinces and IPCUR for the Prairies. University

Liaison at the national level, but not coordination, takes place through the AUCC. In this respect Canada lags far behind such countries as the United States of America, where there has been, for a long time now, a very powerful Federal Agency for the support of Higher Education. Educational liaison at a rather more general level takes place in Canada through the recently formed Council of Ministers of Education.

These varied methods of coordination of university activities on the provincial and national scale are the first stirrings of what might be called a systems approach to Higher Education. We shall hear more and more of this as time goes on. Strong Federal leadership is imperative.

To date, Federal action with respect to Universities has been somewhat sporadic, not particularly effective and always too late and too little. The BNA Act is often named as the villain of the piece but this Act gives the provinces exclusive educational jurisdiction only "in and for each province". It leaves interprovincial and national education unmentioned and this gives the federal government plenty of leeway if it wishes to become more active in this area. In view of the overriding importance nowadays of a first-class system of university education, it seems hard to believe that some way out of the present impasse will not be found. A start has been made in the education office attached to the department of the Secretary of State.

Centres of Excellence

There are, of course, a number of centres of excellence in Canadian Universities. The University of Saskatchewan has developed a number of areas of excellence - agricultural research, including soils research, nuclear research, upper atmosphere research, certain aspects of medical research and so on - each with a very large budget, mostly coming from sources outside the Province. These areas of excellence or centres of excellence require cooperative action among a

group of professors and support of them by the University and others outside the University providing much needed funds. It says a good deal for the adaptability of the University that it has accommodated itself to this aspect of the modern world and has, in fact, shown that the free atmosphere of the University is particularly conducive to the conduct of imaginative scholarly work not only by individual scholars but also by teams of researchers.

A long-range program for the orderly development of centres of excellence in Canadian Universities is long overdue.

Federal Fiscal Transfers in Relation to Higher Education

The effects of the recent change in Federal policy with respect to University support by way of fiscal transfers are still being worked out. There is no doubt that they are having a major effect on University-Government relations. Discussion of the problem is made almost impossible by the almost complete absence of any discernible long-range policy and the absence of a group to develop such a policy or policies and give them some stability. The paucity of the Canadian effort in comparison with that of our neighbors to the south does not bear thinking about. The establishment of a powerful Federal office of Higher Education which might be expected to assume a leadership role is long overdue.

Summary. Towards a National Research Policy

The development of an overall national research policy is particularly difficult for a country such as Canada, consisting as it does of a number of relatively powerful provinces held together constitutionally by the B.N.A. Act which was enacted at a time when research was completely unknown in Canada and higher education about equally so. Subsequent minor amendments to the Act have not recognized the fantastic twentieth century growth of research and higher education and the climate at the second Constitutional Conference held in February,

1969 was such that neither subject was even mentioned publicly let alone debated. However, this does not alter the fact that it is imperative that Canada develop an overall national research policy. About ten years ago, the U.S.A. adopted the device of having a 'Scientific Advisor' to the President -- Great Britain has had a Minister for Science, now a Minister for Education and Science. Just recently in Canada, we have seen the establishment of a Science Secretariat and a Science Council, the latter to advise on high level Science policy. What has become painfully obvious has been the absence of what one might call scientific statesmen, or better 'statesmen scientists', to give leadership in this area of national life. A recent study of the O.E.C.D., 'Towards a National Science Policy', emphasizes the same lack.

From what has been said about the important role of the Universities in the total research picture, it becomes equally urgent to develop policy with respect to research in the Universities. Here coordination is required (a) at the Provincial level to see that there is no unnecessary or wasteful duplication of effort and that major Provincial needs are met and (b) at the national or interprovincial level to see that again there is no overall unnecessary or wasteful duplication of effort and that major national needs are met. All of which is equivalent to saying that there should be a systems approach to research in the universities. As senior partner in the operation, it would seem advisable that the Federal government take the lead in fostering such a systems approach. If this is politically quite impossible, the committee of Provincial Premiers should be urged to undertake this important task

The Role of the Universities in Research - Towards a Systems Approach

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Appendix A: Coordination of Multiple University Systems

APPENDIX A: COORDINATION OF MULTIPLE UNIVERSITY SYSTEMS

In the United States two forms of governance have emerged as the most satisfactory and successful. The first and simpler of these provides a State Board of Regents (in some states called Board of Higher Education), which receives and coordinates the budgets of the individual institutions and submits the combined budget to the Governor of the State for inclusion in his budget message to the Legislature. The Board receives and acts upon the proposals of the individual institutions for the initiation of new graduate programmes, new departments, new degrees, professional schools, institutes, study centres, and so forth. It is to be noted that the authority of this Board covers only those areas that are of importance to the State and the educational community as a whole. It does not concern itself with the internal operation of the various units; faculty appointments and promotions, curricula and courses of study, and so forth. This form of coordination is now well established in Michigan, Illinois, Ohio, Kansas, Texas, and Florida, and is in the process of establishment in Pennsylvania, Georgia, and several other states.

The second pattern is more complex, much more sophisticated and much to be preferred because it provides for the active participation of the university faculties in the governing process and maintains an open line of communication from the institutions to the state government. It consists of the establishment of a State University of which all existing and all future publicly-supported institutions in the state are constituent members. It has well-defined fiscal and academic powers established by statute or by constitutional amendment but preserves a maximum degree of autonomy for each of the constituent universities. At least two of these state systems have operated successfully for very many years. The State University of New York was chartered in 1781; its Board of Regents was established in 1897, and it became a multi-campus university by Act of Legislature in 1948. It now consists of seven universities and 22 colleges. The University of California was chartered in 1868, its Board of Regents was

established by the State Constitution of 1879, and it became a multi-campus university in 1919. Today it includes nine universities and three affiliated colleges. Among the more recently established state systems is the one in Missouri, which now operates four universities with several more about to be added.

During the last ten years the University of Saskatchewan has changed from being one campus to two essentially autonomous campuses whose operations are coordinated by a modified California - SUNY type of organizational structure. The University hopes in this way to achieve the 'Collective Autonomy' spoken about by the Presidents of Ontario committee in their second Annual Review.

University of Saskatchewan

The University of Saskatchewan is governed by the University Act, 1968. Its affairs are managed by a board of management called the Board of Governors of the University of Saskatchewan. The University of Saskatchewan has at present two campuses, one located in Saskatoon, with approximately 10,000 students, the other in Regina, with approximately 4,000 students. Each campus is presided over by a Principal who is the academic and administrative head of his campus. Each campus has an academic Council, to determine academic programmes, and a Finance and Personnel Committee to determine fiscal programmes. Academic programmes are coordinated by the Board of Governors of the University of Saskatchewan which is, effectively, the Board of Management for the whole University. Interposed between the General University Council and the Board is the Senate, a mixed academic-lay body, which acts as our 'window on the world'.

Coordination of Effort

Coordination of business from the two campuses and discussion of matters common to both takes place in the first instance in a University Executive Committee. The two Principals are members of this committee together with the Vice-President (Planning), the Vice-President (Research), the Controller and Treasurer, the

President, and the University Secretary aided by the Director of Planning. The present structure allows for the largest possible degree of decentralization of authority and in line with this, each campus will have its own institutional research group, to keep its operations and procedures under constant review, rather than having a gargantuan overall review group. It is realized that this method of coordinating a multi-campus operation differs from that practised in a province such as Ontario, where there is a University Affairs Commission, but we feel that our method keeps matters in University hands while at the same time striving towards optimum use of scarce resources and funds. Where a number of universities have existed for some years side by side in a province, in the complete absence of any coordinating mechanism, there has been an understandable reluctance to give up any previously held freedom of action or independence. Under such circumstances any form of coordination appears intolerable and only to be submitted to as a last resort. We were perhaps fortunate that we started our dual campus existence in 'double harness' and so did not have to be bludgeoned reluctantly into it.

A good deal of time has been spent on the governance and administration of the University since there is much misunderstanding about it. It bears repetition that while faculty and students determine in large measure the academic excellence and reputation of a University, there is no doubt that the smooth running of the University and the establishment of the desired reputation is greatly helped by a suitable 'mix' of academic knowledge and administrative skill. The operation of a large university is nowadays such a complex affair that in the absence of good administrative practices it would quickly become a shambles. It is to be remarked that the continuous monitoring and upgrading of administrative practices is helped by discussions initiated by C.A.U.B.O., the Canadian Association of University Business Officers.

University-Government Relations

Relationship with the Government becomes increasingly important day by day. The University was originally established by act of the legislature and the University is responsible in the first instance to a Minister of the Government. It is also almost entirely dependent on the Government for its revenues and must each year justify its requested budget to the Government which subsequently approves, by legislative vote, a grant to the University (actually two grants; one operational, one capital). The University grant now forms an appreciable fraction of the Provincial budget and thus comes into competition with other public needs. The situation is aggravated by a rapidly rising budget resulting from rapidly increasing numbers and a certain inevitable escalation due to increase in cost of living. The situation is not, however, hopeless, since governments depend to an increasing degree on the universities. The well-being of the public depends to an ever increasing degree on an adequate supply of doctors, lawyers, dentists, teachers, agriculturalists, etc. etc., and so forth, and to an increasing degree on the researchers, the producers of knowledge. In the Western World the producers of knowledge come mostly from the universities who thus play a key role in our modern society. At the University of Saskatchewan we meet this public obligation by having practically all the customary faculties, except architecture, and a reasonably large graduate school.

While the Provincial Government does not interfere in the internal affairs of the University, it is not unlikely that the maintenance of this state of affairs is dependent in large measure on the degree of responsibility shown by the University in responding to the larger needs of society.

Division of Available Provincial Funds

In a number of provinces, the division of available provincial funds

is made by a committee or a commission, based on the pattern of the British U.G.C., e.g. in Ontario, the University Affairs Committee. In Saskatchewan the division of available funds is made by the Board of Governors on the recommendation of the University Executive Committee. This aspect of our operations is still in the developmental stage. The success of a multi-campus operation is probably very largely dependent on the wisdom with which available funds are distributed.

APPENDIX 90

Brief to the Special Committee on Science Policy
of the Senate of Canada

Presented by

The University of Calgary

A.W.R. Carrothers
President and Vice-Chancellor

18th February, 1969

Calgary, Alberta

"You cannot have a clear, dictated science policy unless it is dictated by God . . . What with the naivete of the natural scientist, the arrogance of the economist, the ignorance of the politician, and the superiority and complacency of the general bureaucrat, there isn't a hope in hell of getting an integration (of science policy with economic, social, defense, and other policies), and this is the situation we're in."

- Alexander King, Director
Scientific Affairs
Organization for Economic
Cooperation & Development

It is perhaps appropriate to quote such a pessimistic viewpoint in introducing a Brief purporting to address itself to the vexed and complex question of establishing a National Science Policy. There can then be no feeling of "let down" if the conclusions reached and the recommendations advanced lack definitiveness or practical detail. The consequences to the Nation, however, of pursuing a policy of scientific endeavor which is, in essence a non-policy are almost as dangerous as those of overstructuring our scientific endeavors and trying to play the role of God in second guessing the future creativity of our fellow men. We must therefore seek the compromise. Not necessarily, in this case, because a compromise is the only solution that could be imposed but rather because, by virtue of our ignorance, such a middle road is the only one that we dare follow. We must keep our options open lest we be damned by future generations for our short sightedness.

This Brief directs its attention to a number of the general terms of reference of The Special Committee on Science Policy but more specifically voices the concerns and the views of a University which, although relatively new, is well established in research. Many of our problems are those also of older and larger universities but some are peculiar to our particular stage of development.

Research Support and How it Should be Provided

Research in universities is not only an essential feature of the established educational and intellectual activities of such institutions but is, equally, essential to the national well being and the economic and cultural development of the country. If this national role is recognized then there can be no question of the propriety of federal assistance to research. It is at this point that we must consider the relative roles of Federal and Provincial governments for this has a direct bearing on how the federal assistance should be provided. Provincial governments have, by their very mandate, primary responsibility for the development of provincial interests. They cannot, therefore, be faulted if in their enthusiasm to achieve these ends they tend to favour provincial needs over national ones. If federal assistance to research is provided in recognition of the national role played by university research then it is clear that such federal assistance must be provided directly

to universities and not through the intermediacy of regional government. Effective research support involves the overlay of federal grants to individual researchers on the institutional grants of the regional governments.

If such assistance is to be provided directly to universities how best may the Federal Government assess the relative need and administer the program? We believe that Canada is already well provided with appropriate mechanisms to achieve this task although improvements are needed. The National Research Council, the Canada Council, the Medical Research Council and numerous more "mission oriented" federal granting agencies are already playing an important role in assessing and administering research aid to universities. They should not be replaced or relegated to a subordinate role by the establishment of some super ministry. Rather should their role and their means to support be strengthened. It is for their future guidance that any Science Policy statement should be prepared. The National Research Council and the Canada Council, in particular, have laboured long and hard to establish viable relationships with the Canadian university system and these hard won benefits should not be swept aside by the stroke of the policy pen. Admirable though these present institutions may be, what are their faults?

a) We recognize that each in its own sphere serves a different research interest and consequently differences in administration policy are necessary. Overlap in the operating fields of federal granting agencies is essential to guarantee a fair hearing for all research proposals, to eliminate or at least minimize personal prejudice and to ensure that research in interdisciplinary areas is supported. The universities, however, each have within their structure academic research units which are supported by the different agencies. Accordingly, it is at the university receiving end that the differences in agency policy are most troublesome and noticeable. We urge that such major policy differences in both assessment and administrative procedures be reviewed.

b) One of the best examples of the impossibility of producing a definitive Science Policy at the national level is our inability to foresee the development of new interdisciplinary areas of research endeavor. A number of these developments, particularly those which straddle the imaginary boundary between the human and the physical and life sciences, tend to fall in the no man's land between the existing granting agencies. Much has been done in recent times to improve the communication between the various federal agencies, particularly between NRC and MRC and between NRC and Canada Council. Even among these major agencies, however, much still remains to be done. They should be encouraged rather than discouraged to provide overlapping research support to ensure that all areas of research endeavor are encompassed. In the area of the "mission oriented agencies" (DRB, Forestry, Agriculture, Fisheries, Geological Survey, AECL, Manpower, Health and Welfare, Industry, etc., etc.) however, the extent to which proposals for research assistance are exchanged is minimal. Much effort and money is wasted in the process by virtue of duplication and eventual frustration on the part of both the university and the agency. We urge that a

more efficient means of communication and interchange of research ideas between federal agencies be established.

c) The concept of annual research grants to researchers is still prevalent among most major federal granting agencies. This policy, while administratively more convenient in view of the annual nature of government appropriations, fails to recognize the increasing complexity and long term nature of fundamental research. We urge that some method be devised to permit longer term commitments for research assistance with appropriate safeguards to allow termination of non-productive projects and to cover inflationary trends during the lifetime of the commitment.

d) Researchers of the immediate future are the graduate students of today. If a national Science Policy is to stand us in good stead for the future it must include generous provision for the support of these "researchers in training". There is a particular need for much improved student support either in the form of direct scholarships or assistance through research grants to established workers. The present level of support is barely adequate in the physical and life sciences and completely inadequate for beginning students in the human sciences. We urge that in any Science Policy statement there be adequate and flexible provision for the support of these "researchers in training" and their research. Specifically, we suggest that there be greater flexibility in the administering of awards to students assisting the research of faculty members with particular reference to the Humanities and Social Sciences. In these areas some of the existing rules governing Canada Council awards are overly restrictive, requiring differential salary scales as between summer and regular employment and not giving the individual faculty member the right to waive such rules. The lower rates prescribed for regular employment periods, in effect require that the full-time graduate students be supported from other sources, and this generally requires a reallocation of internal university funds which, for a variety of reasons, is not infrequently academically and administratively undesirable.

e) The Bladen Commission recommended that serious consideration be given to some modest form of "overhead" to universities associated with research grants from federal agencies. While it may never be specified in any formal accounting every time a university accepts a research grant from any source, it is committing a sizeable sum from its own resources in the form of hidden "overhead costs" associated with the project. It may be argued that in most public institutions these so called "university resources" are also public funds but they are provided primarily for educational purposes and not research. While it would be unrealistic and potentially dangerous to assume that real costing of overhead on research grants could be provided with the grant, as is common in the United States, some form of modest assistance seems little enough to ask. This situation becomes extreme in the case of research contracts with certain federal agencies where, even here, overhead allowances are not permitted. We urge that in the case of all federal contract research with universities real

overhead costs be provided for within the contract and that in the case of research grants-in-aid some modest overhead assistance be provided.

f) Research today in all fields means data-processing costs. These can be staggering and are not likely to diminish with time. While the major federal granting agencies have long recognized the real extent of these costs, they have not been in a position to do much more than give token assistance. Many universities carry an inordinately large share of the real cost of research data-processing. We urge that a national Science Policy address itself directly to the problem of coordination and consolidation of computer facilities in the nation with a view to providing every qualified university researcher and educator with access to required computational facilities.

g) Today's productive research is in large part based on the preliminary findings of the workers of yesteryear. Access to their data is therefore essential; this requires libraries and improved data retrieval systems. The automation of libraries is imminent. The integration of libraries into data retrieval centres will alter traditional concepts. None of the federal granting agencies have done more than offer token support in this area despite the essential nature of this element in the research projects which they support. Interest in this problem is currently high across Canada (vide Downs' Report on University Libraries 1968) and the time is ripe to set the policy which will determine the development of these essential Canadian resources in the 70's. We believe that the federal government must recognize its national role in providing major assistance through its agencies for the development of this invaluable national resource. We urge that any Science Policy clearly define the federal government's role in providing the future libraries necessary for effective and efficient research in Canada.

The Broad Principles of Science Policy

Science Policy presumably covers scientific research. A policy presumes the existence of goals. Achievement of these goals constitutes a mission. Mission-oriented research?

Report No. 4 of the Science Council of Canada, "Towards a National Science Policy for Canada", made much of "mission-oriented research" but, alas, nowhere did the Report define the term. "Basic or Fundamental Research" and "Applied Research" were appropriately defined and we can only assume that "mission-oriented research" is something else again. Assumption, however, is no substitute for assurance in a matter so vital to university research. Universities have traditionally guarded their right to the unencumbered pursuit of knowledge for knowledge sake with such fervent jealousy that even the hint that Canada's National Science Policy will swing heavily in favour of mission oriented research raises every academic hackle in sight. In our understandable enthusiasm to direct our national research effort to the solution of current social and economic problems let us, however, not

forget that the reason why we can even contemplate such a move is that there currently exists a modest cadre of trained researchers to be turned to the task. What set of circumstances led to the existence of this cadre? Are they the result of a couple of decades of a mission-oriented Science Policy in Canada? The answer is clearly negative. Since the end of the Second World War and with increasing impetus Canada has engaged in a rapid build-up of training facilities for researchers based on the concept of free enquiry and broad, generalized higher education. We do not suggest that at this stage in our development there is no place for mission-oriented research or that this is not the time to place increased emphasis on this presumably hybrid activity midway between basic and applied research. As members of the university community, however, we must caution against over-emphasis lest it be interpreted by those charged with executing the Science Policy as a downgrading of the importance of fundamental research. We may appear oversensitive in this regard, but enthusiasm for fundamental enquiry is a frail flower difficult to nurture but easy to destroy. We urge that any statement of Science Policy define clearly the meaning of mission-oriented research and establish beyond any doubt that no form of research can thrive without the continued healthy growth of unencumbered fundamental enquiry in both universities and selected federal and corporate institutions.

Recently the government in the United Kingdom has attempted to impose a "mission-oriented" scientific research policy on the universities and technical colleges of that nation. The object of this policy was to encourage industry to modernize its technology and to design and manufacture sophisticated products so that it could compete more effectively in the world's markets. This policy has been a dismal failure and has accelerated the rate at which the "brain-drain" from the U.K. has been occurring. Canada has been one of the beneficiaries of this drain with the favourable effect of completely counteracting our own "brain-drain" to the United States. It is easy to conclude that Canadian science policy, which places a similar emphasis on "mission-oriented" research, would be disastrous, since it would accelerate the "brain-drain" outflow to the United States while decelerating the inflow from the U.K. and elsewhere.

There is no inherent reason why universities should not engage in mission-oriented research. Indeed, many now do. The promotion of mission-oriented research is essential to the future development of Canada. Furthermore, mission-oriented research programs, if properly selected, can fulfill a vital role in the training of graduate students in professional faculties such as Education, Engineering and Business. Research projects suitable for the training of graduate students should be chosen so as to emphasize and encourage the intellectual development of the student. There is a danger that graduate students are employed as cheap technicians when they become involved in mission-oriented research. Mission-oriented research does not necessarily contravene the academic credo provided it does not become the master in the house. Care must therefore be exercised in the relative proportions of federal funding provided for the support of fundamental as opposed to mission-oriented and applied research in universities.

We urge that those federal agencies currently engaged primarily in the support of fundamental research continue to be generously funded while those mission-oriented federal agencies receive additional funds specifically to support mission-oriented research in their specific areas of interest, both in house and through their university support programs.

Like all other seekers after coin from the public purse, we have been seeking more! As this nation develops there can be little question that her endeavors in physical, life and human science research will continue to represent a larger and larger drain on the public purse. The federal contribution will not be exempt from this escalation and the projections may well appear frightening to those who have grown accustomed to our dependence upon importation of innovation and invention. Nonetheless, it is not unreasonable for those who foot the bill to expect at least a modicum of efficiency in the manner in which their dollars are spent on this apparently insatiable yet unplanable activity called research.

The freedom to engage in fundamental enquiry, so precious to the academic, frequently finds itself extended to mean freedom to research on anything at any time by anybody anywhere. It goes without saying that adoption of this policy quickly produces astronomical projections of future costs. Our point is simple and not a new concept - - the intriguing but politically hazardous concept of Centres of Regional Excellence. We are particularly sensitive to the implied limitations imposed by such a concept being as we are a relatively new university. We are only too conscious of the argument (often fallacious) that it is cheaper and safer to build new excellence on existing excellence than to break new ground (literally). Unqualified acceptance of this argument would generate a vicious circle of non-success. Only flourishing research centres attract the greatest degree of support; generally researchers of repute are attracted primarily to those institutions offering the greatest degree of research support; and in general, it is only those institutions which already have researchers of repute that are considered to be flourishing. This leads, almost invariably, to the consequence that embryonic institutions or departments never attain maturity. Nonetheless, it requires something less than a realistic outlook to argue that proliferation and multiplication of complex and expensive research installations can be permitted without a resulting unacceptable level of inefficiency. We have previously cited examples of such complex and expensive installations - libraries, computer facilities - and it requires little imagination to expand this list to include many modern nuclear research machines, space research facilities, and an ever growing array of modern scientific research equipment with unit costs in excess of \$100,000. There appears to be no truly compelling reason why such major facilities should not be located at appropriate centres across the nation provided that they are operated on a service basis and available, without preference, to all those researchers qualified to use them. A further argument in favour of their maximum utilization is the rapid rate of obsolescence

of such installations. They should not be duplicated unless a sound rationale exists or develops.

Centres of Regional Excellence do not necessarily have as their focal point some particularly sophisticated instrumental facility or collection of data. The geographical regions of the nation provide us with a wide diversity of environments and resources upon which Centres of Excellence may be based. These predominant regional characteristics should also provide a guide to the location of appropriate research centres and should be identified as having special priority in a particular field for federal research support, irrespective of the fact that there may be older, well established research centres. That is, our concept of Centres of Regional Excellence envisages not only, nor necessarily, building upon existing strengths but includes recognition of the need for the creation of new research centres, where, for a variety of reasons, it is predictable that such new centres should eventually surpass in excellence, presently existing centres.

The concept of Centres of Regional Excellence should not be allowed to encroach upon the need for financial support of basic levels of research endeavor at any institution. Universities are, by definition, concerned with all aspects of knowledge and they must be free to follow any direction that their enquiries may suggest. This requires a basic minimal level of support but does not necessarily imply that the more complex and sophisticated paraphernalia of research be provided on each and every campus. Such advanced facilities need only be freely available to the researcher at some central location.

We urge that the concept of Centres of Regional Excellence be incorporated into any statement of Science Policy together with adequate definition of the factors which should be considered in arriving at a decision regarding location and with due regard for the limitations that must be observed in applying concept.

APPENDIX 91

BRIEF TO THE SPECIAL SENATE COMMITTEE

ON

SCIENCE POLICY

Submitted By:

Stephen Watson

Randy Cormack

Michael Marr

Marty Rosove

Grade VIII Students of
J.B. Mitchell Junior High School
1720 Fleet Ave.,
Winnipeg 9, Man.

PROPOSALS OF BRIEF:

1. We propose that the committee must become aware of the necessity for changing the concept of "Text-Books" at the Junior High Level of Science Teaching.
2. We further propose that the committee should recommend in its findings that science be taught in an up to date context through the use of pamphlets or science papers.

We also propose that Science text-books in Canada be issued through a central Federal Government Agency.

Sirs:

We would thank you for the opportunity of presenting this brief before such an august body of lawmakers. We present this brief in the belief that we as students are missing out on some of the most exciting developments in science in perhaps one of the most productive scientific eras of all time simply because our present science text-books are inadequate. We would go further and say that the present standards of science education in the school today are almost stagnant at the junior high level.

We are sure that the gentlemen of this committee realize that this is the time of our lives that our curiosity is the greatest, that our thirst for knowledge is unsatiable, that our desire to know what's going on, and why, is excessive. But what are we faced with? Right now; at this very moment our science text book is over 30 years old.

We realize of course that text books and education are "Provincial matters". But then, gentlemen, we also realize that you are representatives of the Provinces, and perhaps, in the long run the senate will be the central agency of 'affaires provincial'. Perhaps it is already.

Our inquiries among teachers, students, and parents, our research in educational journals and teacher magazines etc reveal, without a doubt, that the science text does not fulfill our needs in this rapidly changing world.

We are told that scientific knowledge has doubled since 1960. We are told that we only learn such a small part of the knowledge that is available. We are also told that our lack of current basic scientific knowledge will in a year or two be the despair of our high school science teachers.

Obviously then, we need more preparation for the intensive science courses we will encounter in high school.

We know that fortunately, our text book will change. We do not wish to deal with the contents of any text book as such, knowing that any contemplated text-book takes at least five years to reach the student. What we are concerned with though, is keeping the content of science courses more up-to-date.

Our research leads us to conclude that there is a current belief in education that keeping science texts "up-to-date" is too costly for the taxpayers of our country. This belief is erroneous.

In our preparations for, and discussions of, this brief, we asked ourselves the question "How can a science text book be kept up to date economically?" We concluded, it cannot. We even wondered why the present hard covered books could not be replaced by paper-backed editions. It was suggested that this would not find too much favor with the text-book makers.

To keep a text book up to date would need the expenditure of much money and require considerable 'instant' research. We investigated many alternatives, and our main proposal concerns the use of what to us appears very feasible, and entirely economical. We refer to the use of science papers (multi-paged pamphlets) in place of science text books. These science papers, or pamphlets, or however they may be titled, would be published monthly by an organization such as the National Research Council and the distribution financed by the Federal Government in cooperation with the Provincial Governments.

At the beginning of each year, every student would be issued a hard covered pressure binder in which to keep the science papers, notes, newspaper clippings etc. Each pamphlet could contain self-testing tests, suggested references, and basic scientific knowledge. It is strongly suggested here, that this basic scientific knowledge be facts and not the "history" of science that seems to be in vogue in present day text books. The format of these papers would basically be the same each year, but would be revised to include current facts.

What we have in mind, is perhaps best illustrated by using the attached sample of an American publication, "Current Science". There are eight pages of up to date material, including pictures, articles, and tests. It is published weekly. The price is \$1.35 a school year or 40 (forty) issues. The price undoubtedly could be lowered with country-wide distribution.

We are suggesting that a similar type of format be issued on a monthly basis and would encompass twenty-four to thirty pages. This would seem to be a reasonable amount to study each month. It is of course foreseeable that entire issues of the American publication could be included in the above proposed Canadian publication.

What the actual cost of producing the suggested pamphlet would be, could not be determined with too great an accuracy. Each pupil would of course retain his "text book" at the end of the year; but although this might seem expensive, it really only adds to the attractiveness of our proposal. All students need reference books; and what better one could you have than the above.

At the same time we know that our present text book costs \$3.62. It has a life expectancy of approximately three years. Three years of "Current Science" would cost only \$4.05. It contains up-to-date material.

To sum up we would like to present our personal thoughts on our proposal. We feel the Science Papers would

- (1) provide more interesting information;
- (2) allow a more imaginative approach to science teaching.
- (3) give the teacher and pupil more scope and flexibility
- (4) encourage more self discovery and delving by pupils
- (5) better prepare us for the future

As an after thought, and in order to obtain some adult consensus, we discussed our proposal with our science teachers. Most of them felt the pamphlets should be used with the text book. One teacher, however, offered the suggestion of printing a paper backed text of about 100 pages every three years. This text would contain the basic facts. The pamphlets would enlarge and expand on the facts in an up-to-date context. This is an interesting suggestion and we are including it in our brief.

APPENDIX 92

BRIEF SUBMITTED TO
THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY
BY
B.W.CURRIE
VICE -PRESIDENT (RESEARCH)
UNIVERSITY OF SASKATCHEWAN, SASKATOON,
SASKATCHEWAN

February, 1969.

The current discussions on a science policy for Canada are failing to recognize the responsibilities and the potential capabilities of our universities for research and consultative services related to the needs of the community or the Province in which each is located. They are limited generally to broad aspects of an overall policy designed to meet the economic and cultural needs of Canada as a whole. The need for adequate support for advanced training and research in universities is recognized, but largely on the premise that the principal function of a university is to supply the trained people required by governmental establishments, industry and business, and the universities themselves.

The universities located in many parts of Canada are the most immediate sources of the "know-how" to investigate problems peculiar to their respective locations, and to provide consultative services to "small" industry. It is true that some departments of the Dominion Government have regional laboratories and establishments, and that many of the Provinces have Research Councils with laboratories; but these are usually limited in their activities. Any integration that exists between their activities and those of their neighbouring

universities depends largely on casual arrangements rather than on well-recognized policies for Canada as a whole. The cumulative effects of a policy which would promote advanced training and research related to local problems within universities located within the less populous and well-developed parts of Canada could contribute much to the economic welfare of the country.

Historically, many of the colleges and universities in the United States and Canada were established to provide groups of trained people to investigate problems related to the economy of the regions in which they were located. Throughout the interior of North America, a college or a school of agriculture was often the first component of a university,--recognizing the need for research to realize the agricultural potential of the regions in which they were located. The first major building on the campus of the University of Saskatchewan was one for the use of the College of Agriculture. Barns for animal studies and plots for crop studies were among the first facilities provided.

Several examples taken from our experiences at the University of Saskatchewan emphasize the merit of professors applying their research skills to local problems. A great need existed in our Provinces during the early decades of this century for varieties of grains better suited to the prevailing climatic conditions and resistant to plant diseases (rusts in particular); another was the rapid deterioration

and failure of concrete structures in Western Canada.

Professor W.P. Thompson, Biology Department, turned his attention to a genetical approach to rust controls in wheat. In collaboration with his colleagues in the Biology and Crop Science Departments and their students rust resistant varieties of wheat were developed. Many of the students progressed to senior positions in governmental establishments and universities where they, in turn, were instrumental in producing improved varieties of plants of great economic value to Canada. Several members of the original group and their students concerned with improved cereal varieties for Western Canada served as consultants to the World Food Organization, organizing groups and training people for crop breeding programmes in the developing countries. The results of these programmes are now being realized by steadily increasing yields of cereals in these countries. No estimate of the value in dollars of these operations which started in a small way from university personnel devoting their time to a local, mission-oriented problem can be made. It has been said that the return to Saskatchewan alone has far exceeded capital and operating costs of the University up to the present time.

Dean C.J. Mackenzie of the College of Engineering undertook to investigate the concrete problem. He was joined by Professor T. Thorvaldson of the Chemistry Department. The first stage showed that the trouble was with the quality of cement and its lack of resistance to alkaline compounds in the

soil. Dr. Thorvaldson and his students investigated the physical and chemical changes occurring in concrete because of the alkaline materials, and experimented with additions to the cement which would increase their resistance to the disintegrating effects of alkaline water. The results were applied to the manufacture of cement, increasing the durability of a structure from ten to a hundred times, and thereby saving millions of dollars. Dr. Thorvaldson's fundamental studies in this area were recognized nationally and internationally by awards from many learned and professional societies.

Another example demonstrates the benefits which can result by close collaboration between a university group and Dominion and Provincial Departments. Little was known up to 1921 about the soil resources of Saskatchewan or of the other Prairie Provinces, and how they could be utilized for crop productions. From a Royal Commission of Inquiry into Farming Conditions (1921) came the Saskatchewan Soils Survey, which has functioned almost from the beginning as a co-operative research group of University, Saskatchewan Department of Agriculture and Canada Department of Agriculture employees, co-ordinated and directed by the Head of the Department of Soil Science. In 1965 the group was given a formal structure by the establishment of the Saskatchewan Institute of Pedology, supported jointly by the University and the two Departments of Agriculture. More than seventy million acres have been examined and classified. About two million acres have been

examined in detail,--particularly their suitability for irrigation by waters from the South Saskatchewan River. A system of comparative soil ratings for grain production was developed. This is now the basis for assessment of agricultural land in Saskatchewan for taxation purposes. A recent, important addition was a Soils Testing Laboratory, operated by the University. A farmer, for a very modest fee, can get tests of the soils on his farm and advice on suitable combinations and quantities of fertilizers required. This service is now used by the majority of the farmers in the Province. Wheat yields for 1967 and 1968 when drought conditions prevailed during critical parts of the growing season were generally much larger than anticipated,--largely from the use of suitable fertilizers. The widespread use of fertilizers is now being reflected in increases in the processing facilities of a number of companies and of their distributing agencies for agricultural fertilizers.

A number of other examples where the University staff alone, or in collaboration with scientists in governmental establishments on the Campus, have been instrumental in initiating investigations and enterprizes of value to the Province and eventually to Canada could be mentioned. These include the production of rape seed and the utilization of oil and meal from it, the testing of farm machinery, and hydrologic and biological productivity studies. For many of these there is a well-defined series of steps. These are:

- (a) recognition of a local problem with some economic implications;
- (b) initiation of research both fundamental and mission-oriented with respect to it; and
- (c) the application of the results of (b) by industry.

Step (a) is usually obvious to researchers in universities located in the region. Step (b) is often difficult to realize because of current policies on the financing of university research. The university researcher often undertakes some fundamental aspect of the problem which can be completed in 2 or 3 years with modest annual grants-in-aid. Sometimes significant progress on the applied aspects is made by collaboration with his colleagues in the applied faculties,-- again with modest annual grants-in-aid. Generally, further progress depends on collaborative efforts by a number of scientists with adequate facilities and technical support. Assured financial support on the required scale for a period of years is usually difficult to get. Step (c) is often the most difficult to achieve. It requires collaborative efforts between the innovators and the developers of a finished product for manufacture and sale to users. Occasionally, step (a) and step (b) in part has been reached by a small industry and the proprietor comes to a university for consultative advice or help needed to overcome basic or applied problems related to his product. Universities and governmental establishments by tradition do not enter actively into step (c). The notable exception is agriculture where

small and large-scale testing of crops, feeding of livestock, etc., are undertaken by agricultural colleges; where extension services are regularly provided; and where the users expect and receive consultative services. With respect to the last, it is interesting to note that numerous farmers on our Prairies have an investment in land and in machinery, or livestock and related facilities, or a combination of these valued at several hundred of thousands of dollars. Each can get the best available advice without charge. The owner of a small plant, or even a large plant, in need of help to improve his product finds it almost impossible to get this service. He is expected to employ the expert help required, or to enter into a contract with research council or university laboratories,--both requiring risk funds which he is unable or hesitant to provide.

Numerous examples can be found of university researchers, attracted by the economic possibilities of ideas developed both inside and outside of universities, who have left their universities to start small firms of their own or to become partners in existing firms in order to participate in step (c). The number who do so to their personal financial gain and to the success of their firms is suprisingly large.

It should be possible for universities in particular to collaborate actively in step (c) when they have the "know-how" and when the projects are ones related to the communities which they serve. Such collaboration requires money for its support--money which universities don't have and

and which it is unlikely that they can get through Provincial votes for their support. The money is needed for a wide variety of purposes,--sometimes for a pilot plant operation, or for development of an idea into a manufactured product; invariably for additional staff to free university personnel from some teaching duties, for space and for technical assistants. A spin-off from such activities within a university is the training which students would get. A common complaint of industry about university graduates is their lack of experience or even appreciation of the economics of the industrial world. Unless process or a device can be utilized in a way to make a profit to a company, there is no merit in spending time or money on it.

One may argue that all the problems peculiar to particular parts of Canada have been recognized and are receiving adequate attention from universities and various governmental organizations. There is little support for such an argument. Numerous problems exist, and many more are becoming evident as Canada grows in population, in industrial sophistication and in the utilization of its resources.

Crop scientists in Western Canada are becoming increasingly alarmed at the decrease in number of people engaged in projects designed to improve the yields of existing varieties of agricultural crops, and to breed new and better varieties with higher yields and more resistance to plant diseases. An Institute of Crop Science attached to a university, has been

recommended on a number of occasions. The annual costs would not be great, but they are ones which a university in Western Canada could not readily provide.

A vast industry has developed in Saskatchewan with the discovery of potash. The general practice of mining the potash by conveyance of the material through tunnels and shafts leaves large amounts of potash to support the over-burden,--potash which may never be recovered. A pollution problem exists with the dust from the mines and the accumulations of sodium chloride on the surface. A more economic method of transport of the potash is desirable,--possibly by pipe-line. A limited amount of research on these problems is in progress at the University of Saskatchewan and the Saskatchewan Research Council; but an Institute of Potash Technology involving university, government departments and industry is needed.

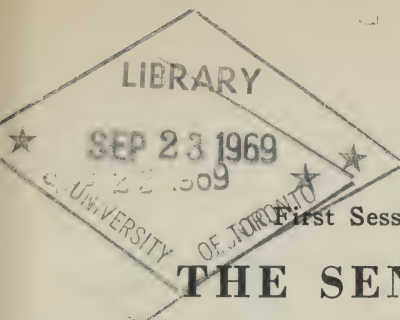
Other examples include the lignite deposits in the southern part of the Province and the uranium deposits in the northern part of the Province. A substantial amount of research, largely basic in nature, has been done by the members of the University Chemistry Department and by the Saskatchewan Research Council. The ultimate utilization of these awaits a policy which would provide long-range support for more fundamental research and subsequent mission-oriented research related to the recovery and utilization of the coal and the uranium. A pilot plant project is needed that would improve the extraction of oil from rape seed and the processing

of the oil so as to make it more palatable. An almost unlimited number of smaller projects become evident to a person who tours the Province and talks with the agriculturists, with persons concerned with the economic utilization and conservation of the natural resources of the Province, and with the managers of many small plants manufacturing articles and materials required locally.

A policy which defines broad, national objectives is desirable, but it can fail to realize the purposes for which it is established. It can provide for national laboratories, for incentives to promote research by "big" industry, for training at the post-secondary level of professional people and highly-skilled technicians, for the rapid dissemination of technical information, and so on. All this is a costly superstructure based on the assumption that it will provide not only the means but the incentives for solving the almost infinite number of small problems that are delaying the economic development of the country.

A policy should recognize the incentives and support for the investigation of the local problems (often national problems when explored in depth) are also necessary. Universities are the organizations best-fitted to recognize them and to initiate the investigations. But they need support to carry them to their logical conclusion,--discovery development and utilization. It would mean close co-operation between fundamental and applied departments in universities,

government establishments in close proximity to them, industry and business. It should result in a bigger return for the dollars spent on research and development, since it could eliminate costly duplication of facilities and research personnel. Following the common terminology, a policy should include specific grass-roots components,--encouragement of research and development directed toward the local and immediate problems by the institutions (universities mostly) closest to them, organization and support of Institutes and Regional Laboratories closely integrated into the activities of particular universities when an activity has reached major economic importance to a region, and support from time to time to universities for enterprizes which would initiate or give impetus to "small" industry.



First Session—Twenty-eighth Parliament
1968-69

**THE SENATE OF CANADA
PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON**

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 49

THURSDAY, MAY 29, 1969

WITNESSES:

Dr. John B. Macdonald, Executive Vice-President, Committee of Presidents of Universities of Ontario; Dr. J. S. Dupré, Director of the Centre for Urban and Community Studies, University of Toronto, Toronto, Ontario; Dr. S. Hunka Co-ordinator of the Division of Educational Research, University of Alberta, Edmonton, Alberta; Dr. R. W. Nicholls, Chairman, Department of Physics, York University, Downsview, Toronto, Ontario; Dr. J. M. Carroll, Associate Professor, Department of Computer Science, University of Western Ontario, London, Ontario; Dr. C. Young, Assistant Professor, Department of Physics, University of New Brunswick, Edmonton, New Brunswick; Dr. L. I. Barber, Vice-President, University of Saskatchewan, Saskatoon, Saskatchewan; Dr. M. J. Keen, Chairman, Department of Geology, Dalhousie University, Halifax, Nova Scotia; Dr. L. Katz, Head, Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan; Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta, Edmonton, Alberta; Dr. J. B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary, Calgary, Alberta; Dr. H. E. Duckworth, Vice-President (Academic), University of Manitoba, Winnipeg, Manitoba; Dr. R. E. Bell, Vice-Dean of Arts & Sciences, McGill University, Montreal, Quebec; Dr. B. W. Currie, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan; Dr. F. A. Forward, Consultant on Research Administration, University of British Columbia, Vancouver, British Columbia; Dr. G. de B. Robinson, Vice-President (Research), University of Toronto, Toronto, Ontario; Dr. G. D. Cormack, Associate Professor, Faculty of Engineering, Carleton University, Ottawa, Ontario; Dr. D. J. McDougall, Department of Geotechnical Science, Loyola College, Montreal, Quebec; Dr. Micheael D. B. Burt, Associate Professor, Department of Biology, University of New Brunswick, Edmonton, New Brunswick; Dr. Samuel Madras, Dean, Faculty of Science, Sir George Williams University, Montreal, Quebec; Dr. W. A. Bridgeo, Dean, Faculty of Science, Saint Mary's University, Halifax, Nova Scotia; Dr. J. F. Postma, Research and Liaison Officer for Academic Development, Notre Dame University of Nelson, Nelson, British Columbia; Dr. Paul B. Hagen, Dean, Faculty of Graduate Studies, University of Ottawa, Ontario.

APPENDIX:

No. 93—Brief submitted by the Canadian Association of Graduate Schools.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969.

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator MacDonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, May 29, 1969

Pursuant to adjournment and notice the special Committee on Science Policy met this day at 3.00. p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Cameron, Carter, Grosart, Haig, Kinnear, Phillips (*Prince*), Robichaud, and Yuzyk—9

In attendance:

Philip J. Pocock, Director of Research (*Physical Science*)

The following witnesses were heard:

Dr. John B. Macdonald, Executive Vice-President, Committee of Presidents of Universities of Ontario;

Dr. J. S. Dupré, Director of the Centre for Urban and Community Studies, University of Toronto, Toronto, Ontario;

Dr. S. Hunka, Co-ordinator of the Division of Educational Research, University of Alberta, Edmonton, Alberta.

Dr. R. W. Nicholls, Chairman, Department of Physics, York University, Downsview, Toronto, Ontario.

Dr. J. M. Carroll, Associate Professor, Department of Computer Science, University of Western Ontario, London, Ontario;

Dr. C. Young, Assistant Professor, Department of Physics, University of New Brunswick, Fredericton, New Brunswick;

Dr. L. I. Barber, Vice-President, University of Saskatchewan, Saskatoon, Saskatchewan;

Dr. M. J. Keen, Chairman, Department of Geology, Dalhousie University, Halifax, Nova Scotia;

Dr. L. Katz, Head, Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan;

Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta, Edmonton, Alberta;

Dr. J. B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary; Calgary, Alberta;

Dr. H. E. Duckworth, Vice-President (Academic) University of Manitoba, Winnipeg, Manitoba;

Dr. R. E. Bell, Vice Dean of Arts & Sciences, McGill University, Montreal, Quebec;

Dr. B. W. Currie, Vice-President (Research), University of Saskatchewan, Saskatoon, Saskatchewan;

Dr. F. A. Forward, Consultant on Research Administration, University of British Columbia, Vancouver, British Columbia;

Dr. G. de B. Robinson, Vice-President (Research), University of Toronto, Toronto, Ontario.

Dr. G. D. Cormack, Associate Professor, Faculty of Engineering, Carleton University, Ottawa, Ontario;

Dr. D. J. McDougall, Department of Geotechnical Science, Loyola College,
Montreal, Quebec;
Dr. Michael D. B. Burt, Associate Professor, Department of Biology,
University of New Brunswick, Fredericton, New Brunswick;
Dr. Samuel Madras, Dean, Faculty of Science, Sir George Williams
University, Montreal, Quebec;
Dr. W. A. Bridgeo, Dean, Faculty of Science, Saint Mary's University,
Halifax, Nova Scotia;
Dr. J. F. Postma, Research and Liaison Officer for Academic Development,
Notre Dame University of Nelson, Nelson, British Columbia;
Dr. Paul B. Hagen, Dean, Faculty of Graduate Studies, University of
Ottawa, Ottawa, Ontario.

(A curriculum vitae of each witness follows these Minutes).

The following is printed as an Appendix:

No. 93—Brief submitted by the Canadian Association of Graduate
Schools.

At 5.30 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick Savoie,
Clerk of the Committee.

Barber, L. I., B.A., B.Comm., M.B.A., D.B.A. Lloyd Ingram Barber, son of Mr. and Mrs. Muir Barber, was born March 8, 1932, in Regina, Saskatchewan. He completed junior matriculation at Regina Beach School in 1948 and senior matriculation at Luther College, Regina, in 1949. He received a Bachelor of Arts (Economics) degree from the University of Saskatchewan in 1953 and a Bachelor of Commerce (Administration) degree from the same University in 1954. In 1955, he received the degree of Master of Business Administration (Marketing) from the University of California (Berkeley). From 1955 until 1962 he taught in the College of Commerce, University of Saskatchewan. He enrolled in the doctoral program in Business Administration at the University of Washington, Seattle, Washington. In 1963, he was awarded a Canada Council Pre-Doctoral Fellowship. In 1964, he received a Summer Dissertation Fellowship from the Ford Foundation. He was awarded the degree of Doctor of Business Administration by the University of Washington in August, 1964. The title of his doctoral thesis is "The Influence of Federal Income Tax on the Growth of Co-operative Merchandising in Canada". He returned to the College of Commerce, University of Saskatchewan, at the rank of Associate Professor. In July, 1965, Dr. Barber was appointed Dean of the College of Commerce, University of Saskatchewan. In October, 1968, he was appointed Vice-President of the University of Saskatchewan. Dr. Barber has had extensive experience outside the academic sphere. In July, 1964, he was appointed as one of three commissioners to the Saskatchewan Royal Commission on Government administration. (The Commission completed its report in August, 1965.) In September, 1965, Dr. Barber was appointed Chairman of the Saskatchewan Youth Review Committee, a committee established to recommend to the Provincial Government appropriate action to improve the social, recreational and cultural opportunities for the youth of Saskatchewan. Dr. Barber is Past President of the Association of Canadian Schools of Business. Dr. Barber has long been associated with a family merchandising and contracting business in Saskatchewan and retains an interest in its affairs. He has frequently been a consultant to business and, in this capacity, appeared before the Carter Commission on Taxation for the Retail Merchants' Association of Canada. He has written several articles on management and marketing topics and is frequently called upon as a speaker. In November, 1967, Dr. Barber was appointed by the Federal Government as a member of the Northwest Territories Legislative Council and, in this capacity, has spent much time and travelled extensively in Canada's north. Dr. Barber is married and has five children.

Bell, Robert E. Born 29 November 1918 in England of Canadian parents: lived in Canada since infancy. Education: Elementary and High School in Ladner, B.C. (near Vancouver). University of British Columbia, 1935-1941: B.A. in Honours Mathematics and Physics, 1939. M.A. in Physics, 1941. Three scholarships. McGill University, 1945-1946 in residence, 1946-1948 working on research: Ph.D. in Physics, 1948. N.R.C. Fellowship, 1945-1946. Employment: 1941-1945—Wartime research and development of radar, National Research

Council, Ottawa. 1946-1952—Nuclear Physics research at the Atomic Energy Project, Chalk River Laboratories. 1952-1956—On loan from Chalk River Laboratories to Radiation Laboratory (now J. S. Foster Radiation Laboratory), Physics Department, McGill University, as Research Associate. Left the employ of Chalk River in September 1956 with the rank of Senior Research Officer. 1956-1958—On staff of Physics Department, McGill University, as Associate Professor. 1958-1959—Spent a year of work and study at Niels Bohr's Institute for Theoretical Physics, Copenhagen. 1960—Appointed Rutherford Professor of Physics, and Director of the Foster Radiation Laboratory, McGill University. 1964-1967—Vice-Dean for Physical Sciences, McGill University. Memberships and Distinctions: Fellow of the Royal Society (London) 1965. Fellow of the Royal Society of Canada 1955 and Secretary of Section III (Science) 1962-1964. Fellow of the American Physical Society 1954; Councillor 1965-1967. President of the Canadian Association of Physicists 1965-1966; C.A.P. Medal for Achievement in Physics 1968. Member of the Society of the Sigma Xi. Member of the Canadian National Committee of the International Union of Pure and Applied Physics and Corresponding Member of the Commission on Low Energy Nuclear Physics. Canadian Centennial Medal 1967.

Theses, Publications, and Patents:

1. *Theses*: "On the Ultraviolet Spectrum of the Hydrogen-Deuterium Molecule" (M. A. Thesis, University of B.C., 1941). "Gamma Rays of Neutron Capture Studied with the Beta Ray Spectrometer" (Ph.D. Thesis, McGill University, 1948).

2. *Publications* (names of co-authors given in parentheses where applicable): "Disintegration Scheme of 1.7 Year Cesium 134", (with L. G. Elliott). *Physical Review* 72, 979 (1947). "Experimental Upper Limit for the Mean Life of the 478.5 keV Excited State of Lithium 7", (with L. G. Elliott). *Physical Review* 74, 1869 (1948). "Lifetime of the 479 keV Excited State of Lithium 7", (with L. G. Elliott). *Physical Review* 76, 168 (1949). "Gamma Rays from the Reaction $H^1(n, \gamma)D^2$ and the Binding Energy of the Deuteron", (with L. G. Elliott). *Physical Review* 74, 1552 (1948) and *Physical Review* 79, 282 (1950). "Search for a 3.20 MeV Gamma Ray in the Disintegration of Thorium C", (with L. G. Elliott). *Can. J. Research A26*, 379 (1948). "Upper Limit for the Lifetime of the 411-keV Excited State of ^{198}Hg ", (with H. E. Petch). *Physical Review* 76, 1409 (1949). "Measurement of a 1.6×10^{-6} Second Half-Life in ^{170}Yb ", (with R. L. Graham). *Physical Review* 78, 490 (1950). "Half Lives of Excited States of ^{160}Hg , ^{131}Xe , and ^{198}Hg ", (with R. L. Graham). *Physical Review* 84, 380 (1951). "Design and Use of a Coincidence Circuit of Short Resolving Time", with R. L. Graham and H. E. Petch). *Can. J. Physics* 30, 35 (1952). "Disintegration Scheme of ^{131}I ", (with R. L. Graham). *Physical Review* 86, 212 (1952). "Wide Range Logarithmic Radiation Meter", (with R. L. Graham). *Review of Scientific Instruments* 23, 201 (1952). "The Disintegration of ^{170}Tm ", (with R. L. Graham and J. L. Wolfson). *Can. J. Physics* 30, 459 (1952). "The Determination of the Half Lives of Some Magnetic Dipole Gamma Ray Transitions", (with R. L. Graham). *Can. J. Physics* 31, 377 (1953). "Time Distribution of Positron Annihilation in Liquids and Solids", (with R. L. Graham). *Physical Review* 90, 644 (1953). "Search for a Possible Error in the Measured Half Life of ^{198}Au ", (with L. Yaffe). *Can. J. Physics* 32,

416 (1954). "The Thermal Neutron Capture Cross Section of ^{198}Au and the Half-Life of ^{198}Au ", (with R. L. Graham and L. Yaffe). *Can. J. Physics* 33, 457 (1955). "Nuclear Particle Detection: Fast Electronics" (Annual Reviews of Nuclear Science, Stanford, California, Vol. IV, 1954). "Measurement of Short Lifetimes" "Disintegration of Iodine 131" "Annihilation of Positrons in Liquids and Solids (Chapters in Beta-and Gamma-Ray Spectroscopy, K. Siegbahn, editor, North-Holland Publishing Co., Amsterdam, (1955). "The Resolver, A. Circuit for Reducing the Counting Losses of a Scaler", *Can. J. Physics* 34, 563 (1956). "Cross Sections of (p, xn) Reactions in the Isotopes of Lead and Bismuth", (with H. M. Skarsgard), *Can. J. Physics* 34, 745 (1956). "Variations in the Amounts of Positronium Formed in Liquids and Amorphous Solids", (with R. E. Green). *Can. J. Physics* 35, 398 (1957). "Notes on a Fast Time-to-Amplitude Converter", (with R. E. Green). *Nuclear Instruments* 3, 127 (1958). "Genetic Measurement of the Half Life of ^{207}Bi ", (with J. Sosniak). *Can. J. Physics* 37, 1 (1959). "Half Lives of First Excited States of Even Nuclei of Em, Ra, Th, U, and Pu", (with S. Bjørnholm and J. C. Severiens). *Matematiskfysiske Meddelelser, Kongelige Danske Videnskabsbernes Selskab* 32, no. 12 (1960). "The Half Life of the First Excited State of ^{203}Tl ", (with E. C. B. Pederson). *Nuclear Physics* 21, 393 (1960). "Method of Evaluating Delayed Coincidence Experiments", (with R. S. Weaver). *Nuclear Instruments and Methods* 9, 149 (1960). "More Power for McGill Cyclotron", *Canadian Nuclear Technology* 1, no. 2, 31 (1961). "Higher Order Events in Coincidence Counting". *Nuclear Instruments and Methods* 12, 199 (1961). "Cross Sections of (p,pxn) Reactions in ^{197}Au ", (with T. M. Kavanagh). *Can. J. of Physics* 39, 1172 (1961). "A Simple and Accurate Method for Calibrating Nanosecond Time-to-Pulse-Height Converters", (with R. L. Graham, J. S. Geiger, and R. Barton). *Nuclear Instruments and Methods* 15, 40 (1962). "Dependence of Line Widths of Scintillation Counters on Integrating Time Constant", (with P. Onno). *Nuclear Instruments and Methods* 17, 149 (1962). "McGill Discovers New Type of Radioactivity", (with R. Barton and R. McPherson). *Canadian Nuclear Technology* 3, no. 3 (1963). "Observation of Delayed Proton Radioactivity", (with R. Barton, R. McPherson, W. R. Frisken, W. T. Link, and R. B. Moore). *Can. J. Physics* 41, 2007 (1963). "Delayed Proton Emission Following the Decay of ^{27}Ne ", (with R. McPherson and J. C. Hardy). *Physics Letters* 11, 65 (1964). "Coincidence Techniques and the Measurement of Short Mean Lives", Chapter 17 of Alpha, Beta, and Gamma Ray Spectroscopy, K. Siegbahn, editor, North-Holland Publishing Co., 1964. "Three Problems on Random Events", *Am. J. Physics* 33, 219 (1965). "Decay of Carbon-9", (with J. C. Hardy and R. I. Verrall), *Physical Rev. Lett.* 14, B553 (1965). "New Information on the Emission of Delayed Protons Following the Decay of ^{17}Ne , ^{21}Mg , and ^{28}Si ", (with J. C. Hardy). *Can. J. Physics* 43, 1671 (1965). "J. S. Foster, 1890-1964", *Proc. Roy. Soc. Can., Fourth Series, Vol. III*, 101 (1965). "Superalowed log ft Values for Transitions Between T= 3/2 Analogue States", (with J. C. Hardy and R. I. Verrall). *Nuclear Physics* 81, 113 (1966). "An Extended Nomogram for Log ft Values", (with R. I. Verrall and J. C. Hardy). *Nuclear Instruments and Methods* 42, 258 (1966). "Comparison of Leading-Edge and Crossover Timing in Coincidence Measurements". *Nuclear Instruments and Methods* 42, 211 (1966). "J. S. Foster, 1890-1964", *Biog. Memoirs Fellows R.S.* 12, 147 (1966). "Statistics of a Two-Parameter Analyzer with Associative Memory". *Nuclear Instruments and Methods* 50, 258 (1967).

"Proton Radioactivity", *Encyclopaedic Dictionary of Physics*, J. Thewlis, ed., Pergamon Press, 1968. "Direct Measurement of the Primary Photoelectron Yield in Sodium Iodide Scintillation Counters" (with A. Houdayer and S. K. Mark). *Nuclear Instruments and Methods* 59, 319 (1968). "Square Root Graph Paper for Nuclear Spectra" (with R. I. Verrall). *Nuclear Instruments and Methods*, accepted for publication in 1968.

3. *Patents*: "Coincidence Circuit", U.S. Patent no. 2,610,303 (issued September 9, 1952). (Also Canadian Patent issued 1953).

Bridgeo, W. A. Born December 15, 1927, Saint John, N.B. 1933-1944, St. Vincent's Boys School, Saint John, N.B., Elementary & High School; 1944-1948, St. Francis Xavier University, Antigonish, N.S., University education, B.Sc.; 1948-1949, Nova Scotia Research Foundation, Halifax, N.S., Analytical Chemist (also part-time study at Dalhousie University, Halifax, N.S.; 1949-1950, Laval University, Quebec, P.Q., Graduate study—Chemistry; 1950-1952, University of Ottawa, Ottawa, Ontario, Graduate study—Chemistry, received Ph.D.; 1952-1953, Notre Dame University, South Bend, Ind., Further Study; 1953-1958, Nova Scotia Research Foundation, Halifax, N.S., Wide range of duties re. service to industry; 1958-1961, Nova Scotia Research Foundation, Halifax, N.S., Director, Technical Services Division; 1961-1963, New York State University, Alfred, N.Y., Research on Fuel Cells; 1963-1965, Saint Mary's University, Halifax, N.S., Associate Professor, Chemistry; Nova Scotia Research Foundation, Halifax, N.S., Director, Technical Services Division; 1965-1967, Saint Mary's University, Halifax, N.S., Associate Professor, Chemistry; Nova Scotia Research Foundation, Halifax, N.S., Director, Chemistry Division; 1967-present, Saint Mary's University, Halifax, N.S., Dean of Science; Nova Scotia Research Foundation, Halifax, N.S., Director, Chemistry Division.

Burt, Michael David Brunskill. Date and Place of Birth: January 19, 1938; Colombo, Ceylon. Marital Status. Married, with four children. Position. Associate Professor. Department: Biology. Institution: University of New Brunswick. Degrees and Qualifications: B.Sc. (First Class Honours) in Zoology with Parasitology as special subject. University of St. Andrews, Scotland, 1961; Ph.D. for a thesis entitled "Parasitological Studies". University of St. Andrews, Scotland, 1967 F.L.S. elected in 1966. Academic and Research Experience: 1956-1957 University of St. Andrews, Scotland; 1957-1958 Union College, Schenectady, N.Y., U.S.A. on a C. Vreeder Scholarship; 1958-1961 University of St. Andrews, Scotland; 1961-1962 Assistant Professor, Department of Biology, University of New Brunswick; 1962 (summer) Research Assistant to Dr. T. W. M. Cameron, Institute of Parasitology, Macdonald College, P.Q.; 1962-1964 Research student and senior demonstrator, University of St. Andrews, Scotland; 1963 (summer) British Council Research Scholarship for study at the Université de Neuchâtel, Switzerland under the direction of Professor J. G. Baer; 1964-1968 Assistant Professor, Department of Biology, University of New Brunswick; 1968-present Associate Professor, Department of Biology, University of New Brunswick. Number of Publications: Nine, on Parasitology.

Carroll, John M. Education: Bachelor's in Industrial Engineering (with highest honours) Lehigh University, Bethlehem, Pa. (1950); Master's in Physics, Hofstra University, Hempstead, N.Y. (1955); Doctorate in Industrial Engineering and Operations Research, New York University, New York, N.Y. (1968).

Experience: July 1968 to present, Associate Professor of Computer Science, the University of Western Ontario, London, Ontario; Sept. 1964 to July 1968, Associate Professor of Industrial Engineering, Lehigh University, Bethlehem, Pa.; Feb. 1952 to Sept. 1964, Editorial Staff, *Electronics* magazine, McGraw-Hill Inc., New York, N.Y., Managing Editor from 1957 to 1964; Aug. 1950 to Feb. 1952, Electronics Officer, U.S. Navy. Oct. 1947 to Sept. 1948, Senior Radio Engineering Aide, U.S. National Bureau of Standards, Washington, D.C.; Aug. 1944 to Oct. 1947, Electronics Technician, U.S. Navy. Publications: 14 books and about 40 articles including: "The Standard Handbook for Electrical Engineers" (McGraw-Hill, 1968), Associate Editor; author of section on "Electronic Data Processing". "Characteristics of Modern Production" (Alexander Hamilton Institute 1969). "Careers and Opportunities in Electronics (E.P. Dutton Co., 1967). "Careers and Opportunities in Computer Science" (E. P. Dutton Co., 1962). Research interest are in information systems design including automatic indexing, on-line data collection and analysis, and computer-controlled product verification.

Cormack, George D. Born Alberta, September 11, 1933; married; three children. Attended schools in Calgary and in Victoria, B.C. obtained B.A.Sc. (engineering physics) from U.B.C. in 1955. Awarded English Electric Fellowship to study nuclear reactor design in Great Britain (1955-1957). 1957-1959, Project engineer with Computing Devices of Canada Ltd. in Ottawa, Quebec City and Camden, N.J. 1959-1962, M.Sc. and Ph.D. from U.B.C. in physics for electromagnetic shock tube research. Awarded B.C. Telephone Co. Scholarship, NRC Fellowship, and NATO Postdoctoral Fellowship, the latter held at plasma physics research institutes in Munich and Stockholm during 1962-1964. 1964-present, Member of the Faculty of Engineering, Carleton University, Ottawa. Author of about 20 technical papers on plasmas, systems engineering and instrumentation. Acted as consultant on plasmas to NRC and to the Space Science Division of Computing Devices of Canada. Presently consultant on transmission lines to the Research and Development Laboratories of Northern Electric Co. Ltd. and Associate Professor of Engineering at Carleton University, where major concern in with advanced techniques for energy conversion.

Currie, B. W. Dr. Currie is renowned for his extensive work on aurora borealis and is director of the University of Saskatchewan's Institute of Upper Atmospheric Physics. In 1958 he was in Moscow for two weeks for meetings connected with the International Geophysical Year. He has been president of the Canadian Association of Physicists, a member of the American Geophysical Union, and the American Meteorological Society. He is a fellow of the Royal Society of Canada and the Royal Meteorological Society. Professor Currie has served on numerous associate committees of the National Research Council and the Defence Research Board, in particular—the Associate Committee on Geodesy and Geophysics; Associate Committee on Radio Science; Extra-mural Electronic Panel of Defence Research Board; Leader, Canadian Delegation to 1960 Assembly, International Union of Geodesy and Geophysics. Dr. Currie is a graduate of the University of Saskatchewan. He received the degree of bachelor of science (B.Sc.) in 1925 and the degree of master of science (M.Sc.) in 1927. Three years later he received the doctor of philosophy degree (Ph D.) from McGill University. Dr. Currie joined the staff of the U of S in 1929.

He was on leave from the university from 1932-34 to serve as a meteorologist in the Canadian Meteorology Service. In 1952 he became head of the physics department (a position he relinquished Sept. 1961 in order to allow him more time to devote to his increasing responsibilities.) On July 1, 1959 he was appointed Dean of the College of Graduate Studies. In June, 1962 he was awarded the Canadian Association of Physicists gold medal. The medal is awarded annually by the association for achievement in physics and Dr. Currie was the seventh person to receive the award. He has published numerous papers in his special field, the aurora borealis, as well as papers on earth currents and meteorology. He was president of the University of Saskatchewan Alumni Association for two terms, 1945-46 and 1946-47, and was president of the Faculty Club in 1958. Dr. Currie was born in Helena, Montana, and attended high school at Netherhill, Sask. He is married and has a son and two daughters. Dr. Currie was appointed dean of faculties in December, 1964. This appointment is an administrative one which may be considered to take the place of a vice-president (academic) for the Saskatoon campus. Dr. Currie was named vice-president (research) in April of 1967.

Duckworth, Henry Edmison. Born: Brandon, Manitoba, November 1, 1915 —only child of the late Reverend Henry B. Duckworth, D.D. and Ann Edmison Duckworth. 1935, B.A. (University of Manitoba); 1936, B.Sc. (University of Manitoba); 1937, Teaching Certificate (University of Manitoba); 1937-38, Instructor in Mathematics, Stonewall (Manitoba) Collegiate; 1938-1940, Lecturer in Physics, United College, Manitoba; 1942, Ph.D. (University of Chicago); 1942-45, Defence research work at the National Research Council; 1945-46, Assistant Professor of Physics, University of Manitoba; 1946-51, Associate Professor of Physics, Wesleyan University, Connecticut; 1951-65, Professor of Physics, McMaster University, Hamilton, Ontario; 1956-61, Chairman, Department of Physics, McMaster University, Hamilton; 1961-65, Dean of Graduate Studies, McMaster University, Hamilton; 1963-65, Member of Board of Governors, McMaster University, Hamilton; 1965-66, Vice-President (Development), University of Manitoba; 1966, Vice-President (Academic), University of Manitoba; 1954, Elected to Fellowship in the Royal Society of Canada; Elected to Fellowship in the American Physical Society; 1955, Nuffield Travelling Fellowship; 1961, University of Manitoba Jubilee Award; 1964, Medal of the Canadian Association of Physicists; 1965, Tory Medal of the Royal Society of Canada; 1966, D.Sc. (University of Ottawa); 1966, Honourary Fellow (United College); 1956-62, Editor of the Canadian Journal of Physics; 1961-67, Member, Honourary Advisory Council, National Research Council; 1963, Leader of Canadian Delegation to General Assembly of International Union of Pure and Applied Physics, Warsaw, Poland; 1960, President, Canadian Association of Physicists; 1964, President, Section III (Science Section) of the Royal Society of Canada; Member Defence Research Board; Member Manitoba Research Council; Chairman Committee on Extramural Research, Defence Research Board; Chairman IUPAP Commission on Atomic Masses and Related Constants; Director Manitoba Institute of Management; Publications: 1958, "Mass Spectroscopy", in the Cambridge Monographs on Physics Series, Cambridge University Press, England 206 pages; 1960, "Electricity and Magnetism", Macmillan Company of Canada (Tor.) and Holt Rinehart & Winston (New York), 424 pages; 1960 (Editor of) "Proceedings of the International Con-

ference on Nuclidic Masses", University of Toronto Press, 539 pages; 1963, "Little Men in the Unseen World", Macmillan and Company Ltd. (London and Toronto), 149 pages; numerous scientific articles.

Dupré, J. Stefan. Born Quebec, Que., November 3, 1936. Married 1963. B.A. (University of Ottawa), 1955; A.M. (Harvard University), 1957; Ph.D. (*ibid.*), 1958. *Teaching Positions:* Harvard University: Teaching Fellow in Government, 1956-57; Instructor in Government, 1958-59; Assistant Professor of Government, 1961-63; University of Toronto: Associate Professor of Political Economy, 1963-66; Professor of Political Economy, 1966-. *Academic Administration:* Secretary of the Graduate School of Public Administration, Harvard University, 1960-63; Director of the Centre for Urban and Community Studies, University of Toronto, 1966-. *Other Positions:* Research Fellow, The Brookings Institution, Washington, D.C., 1957-58; Ford Foundation Law Fellow, University of Wisconsin, 1959; Editorial Director, The Ontario Committee on Taxation, 1964-67; Member, Ontario Civil Service Arbitration Board, 1965-; Member, Science Council — Canada Council Study Group on Federal Support of University Research, 1967-68; National Vice President, Institute of Public Administration of Canada, 1967-; Member, National Research Council of Canada, 1969-. Author: *Intergovernmental Finance in Ontario* (1968); *Science and the Nation* (with S. A. Lakoff, 1962); many articles on public administration, public finance and intergovernmental relations.

Forward, Frank Arthur, B.A.Sc., P.Eng., F.I.M., F.C.I.C., M. Inst. M.M., M.C.I.M., D.Sc. Dr. Forward was born in Ottawa in 1902, attended Ottawa Model School, Lisgar Collegiate and University of Toronto where he received the degree of B.A.Sc. (Honours) in Chemical Engineering in 1924. From 1924 to 1929 he was a smelter operator and research metallurgist with Consolidated Mining and Smelting Company of Canada Ltd. at Trail, B.C. Moving to Australia in 1929 he was Assistant Smelter Superintendent, Mount Isa Mines Ltd., Mount Isa, Queensland, until 1934 when he returned to Canada, spending one year as metallurgist with B.C. Nickel Mines Ltd. He joined the University of British Columbia as Assistant Professor of Metallurgy in 1935, became Professor in 1941 and Head of the Department in 1945 a post he retained until 1964 when he was granted leave by the University to go to Ottawa to become the first director of the Science Secretariat in the Privy Council Office. In this post he was responsible for the initial organization of the Science Secretariat and the preparation of material for the Science Council Act, and the organization of Science Council staff. He retired from this post, and from his university position, in 1967. Since July 1967 he has been Consultant on Research Administration, The University of British Columbia and Consultant to Sheritt Gordon Mines Limited. In the period since 1937 he has acted as consultant to Sumitomo Company, Niihama, Japan; Algoma Ore Properties; B.C. War Metals Research Board (Technical Director); Freeport Sulphur Company, New York; Chinese National Resources Commission, Formosa; Sheritt Gordon Mines Limited; Canadian Uranium Research Foundation (Director of Research). He was the first Chairman B.C. Chapter, American Society for Metals in 1941; Vice-President Canadian Institute of Mining and Metallurgy, in 1943-44; President, B.C. Association of Professional Engineers, 1948; President, Dominion Council of Professional Engineers, 1949; Member, Canadian Delegation to First Atoms for Peace Confer-

ence in Geneva, 1955; Member, National Research Council, 1962-64; President, Canadian Institute of Mining and Metallurgy, 1965. In 1955 he was awarded the Leonard Medal, Engineering Institute of Canada; the Inco Medal, Canadian Institute of Mining and Metallurgy, and the McCharles Prize, University of Toronto; in 1959 the Mining World Achievement Award; 1960 the John Scott Award by the City of Philadelphia; in 1962 the Gold Medal of the Institution of Mining and Metallurgy and the R.S. Jane Memorial Lecture Award by the Chemical Institute of Canada; 1963 the Engineering Alumni Medal, University of Toronto; in 1965 the James Douglas Gold Medal, A.I.M.E. and the honorary D.Sc. degree by the University of British Columbia; 1966 the Institute of Metals Platinum Medal and in 1967 the American Academy of Achievement Golden Plate Award. Dr. Forward is a Fellow of the Chemical Institute of Canada and of the Institution of Metallurgists (Gt.Br.), a member of the Canadian Institute of Mining and Metallurgy, American Institute of Mining, Metallurgical and Petroleum Engineer, Australasian Institute of Mining and Metallurgy, Institution of Mining and Metallurgy (Gt.Br.), Institute of Metals (Gt.Br.), Gesellschaft Deutscher Metallhütten u. Bergleute, Canadian Research Management Association. Author of some 30 technical papers including section on "Hydrometallurgy" in Encyclopedia Britannica, 1961 ed. Inventor of pressure leaching process for nickel ores and processes for recovering tungsten, uranium, lead, zinc, tin, resulting in considerable number of patents. Married, 1927, to Dorothy Christina Ransom, they have four sons; Peter (B.Com.), Alan (MD., F.R.C.S. [C]), Gordon (D.Sc.), Nelson (B.Com.).

Hagen, Paul Beo. B. February 15, 1920 in Sydney, N.S.W., Australia. Nationality: Canadian. Marital status: Married, 2 children. DEGREE: Graduate in Medicine, University of Sydney, 1945. POSITIONS HELD: Intern, Balmain Hospital, Sydney, N.S.W., Australia, 1945. Medical Officer, N.S.W. Health Department; also Departmental Demonstrator in Biochemistry, University of Sydney and Lecturer in Physiological Chemistry, Sydney Technical College, 1946-48. Lecturer in Physiology, University of Sydney, 1948-50. Senior Lecturer in Physiology, University of Sydney; also Supervisor of Postgraduate Teaching in Physiology (including Biochemistry and Pharmacology) for the Postgraduate Committee in Medicine of the University of Sydney, 1950-51. Senior Lecturer in Physiology, University of Queensland; also examiner for Postgraduate Medical Degrees and Diplomas, University of Queensland, 1951-52. C. J. Martin Fellow in Medical Research, Department of Pharmacology, University of Oxford, 1952-54. Tutor in Biochemistry, Worcester College, 1953-54. Assistant Professor, Department of Pharmacology, Yale University, 1954-56. James Hudson Brown Fellow, 1954-55. Winner of Lederle Faculty Award, 1956. Assistant Professor, Department of Pharmacology, Harvard Medical School, Boston, Massachusetts, U.S.A., 1956-59; also Director NIH graduate training grant program in Pharmacology, Harvard Medical School, 1957-59. Professor and Head of the Department of Biochemistry, University of Manitoba, Winnipeg, Canada, 1959-64. Professor and Head of the Department of Biochemistry, Queen's University, Kingston, Ontario, Canada, 1964-67. Scientific Officer, Medical Research Council (N. R. C. Director), Professor of Biochemistry, Queen's University, 1967-68. PRESENT POSITION: Dean of the Faculty of Graduate Studies, University of Ottawa, Ottawa, Ontario, Canada, 1969. OTHER ACTIVITIES: Elected Fellow of Chemical Institute of Canada, 1962. Member of

Medical Research Advisory Board of the Muscular Dystrophy Association of Canada, 1960-69. Member of Sub-committee for Biochemistry of the Medical Research Council (Canada), 1962-66. Vice-Chairman of Biochemistry Division, Chemical Institute of Canada, 1962-63. Chairman of Biochemistry Division, Chemical Institute of Canada, 1963-64. Member of Council of Canadian Biochemical Society, 1963-66. Member of Metabolism Committee of Medical Research Council (Canada), 1966-67. Vice-Chairman of the Medical Research Council (Canada), 1967. Recipient of Centennial Medal of Government of Canada, 1968. Member of the Editorial Boards of: *Journal of Pharmacology and Experimental Therapeutics*, 1960-64. *Biochemical Pharmacology*, 1961-66. *Canadian Journal of Biochemistry*, 1964-67. SOCIETY MEMBERSHIPS: Chemical Institute of Canada; Canadian Biochemical Society; American Chemical Society; American Society for Pharmacology and Experimental Therapeutics; American Association for Advancement of Science; Biochemical Society (Great Britain); British Pharmacological Society; Physiological Society, (Great Britain).

Hunka, Stephen M. Born: Trochu, Alberta, August 16, 1931, Present Position: Co-ordinator of the Division of Educational Research Services, The University of Alberta. Stephen Hunka presently holds the academic rank of professor in the Department of Educational psychology, with joint appointments in the Departments of Medicine and Computing Science. He received his bachelor's and master's degrees from the University of Alberta, and his Ph.D. degree in Education and Psychology from the University of Illinois. He has been with the University of Alberta for the past eight years. During his graduate training at the University of Illinois he was a Johnson Fellowship holder, and also served as a research assistant to Dr. H. Kaiser of the Bureau of Educational Research. His main duties involved programming the Illiac computer. He presently teaches courses in numerical and statistical models as they relate to educational applications, and in addition to conducting research in this area, is involved with research in computer-assisted-instruction using the only IBM 1500 System in Canada. He is also a member of the R. S. McLaughlin Medical Evaluation Research Center. He has published in the *Review of Educational Research*, *Harvard Educational Review*, *Psychological Reports*, *Mental Measurements Yearbook*, *Journal of the Canadian Medical Association*, the *Journal of Medical Education*, the *Journal of Administration and Supervision*, and is co-author of the book, *Cognitive Processes* (Prentice-Hall, 1964). He is presently engaged in co-authoring a book with Dr. Hicks of Coordinated Systems Laboratory, University of Illinois.

Hyne, Dr. James Bissett. Dr. James Bissett Hyne, chemist, was born in Dundee, Scotland, Nov. 23, 1929, the son of William and Winnifred (Bisset) Hyne. Dr. Hyne came from Scotland to Ottawa, Ont. in 1954. Dr. Hyne married Ada Leah Jacobson of Boston, Mass. U.S.A. on Sept. 3, 1958. He received his public school education in Dundee, Scotland and high school at Morgan Academy, Dundee, Scotland. He attended St. Andrews University and obtained his B.Sc. (Honors) in 1951; in 1954 his Ph.D. at the same university; Fellowship in Chemical Institute of Canada (F.C.I.C.) 1964. He is a member of Sigma Xi fraternity. From 1954-56 he was post doctorate fellow chemist with N.R.C. (National Research Council), Ottawa, Ont.; 1956-59, instructor of chemistry, Yale University, New

Haven, Conn., U.S.A. 1959-60, assistant professor (chemistry), Dartmouth College, Hanover, N.H., U.S.A. In 1960 Dr. Hyne joined the Faculty at the University of Alberta (now University of Calgary) as an associate professor of chemistry, and administrative officer (dept. of chemistry). In 1963 he was appointed head of dept. of chemistry. In 1964 he became full professor of chemistry, and 1966 to present he is Professor of Chemistry and Dean of Faculty of graduate studies. He is also research director, Alberta Sulphur Research Ltd., 1964 to present, consultant chemist, and a small rancher. Dr. Hyne served from 1947-54 in the U.K. Territorial Army, and joined as private and was discharged with the rank of Company Sergeant Major. From 1954-58 he was in the Cameron Highlanders of Ottawa, Ont. with the rank of second lieutenant. Active in business and professional organizations he is a fellow of the Chemical Institute of Canada and was secretary and treasurer of the organic division, 1963-65; member, American Chemical Society; Faraday Society; Canadian Associate Graduate Schools, Interim Faculty Representative Board of Governors, University of Calgary, 1968. Dr. Hyne has published fifty scientific papers to date. He was the recipient of a Medal in Geology in 1948 at St. Andrews University; 1951-54 University Research Scholarship at the same University; 1954-56 Post Doctoral Fellowship, Ottawa with the N.R.C., and in 1967 he received the Canadian Centennial Medal.

Katz, Leon. Nuclear physicist, educator; born, Ukraine, Russia, August 9, 1909; son of Jacob and Malka Katz; B.Sc., Queen's University, 1934, M.Sc., 1936; Ph.D., California Institute of Technology, 1942; married Georgina May Caverly, January 4, 1941; children—Sylvan, Zender, David, Faye. Research engineer, Westinghouse Electric Corporation, Pittsburgh, 1942-46; associate professor of physics, University of Saskatchewan, Saskatoon, 1946-52; professor of physics, 1952- ; head, department of physics, 1965- ; director, Accelerator Laboratory, 1961- ; member, Science Council of Canada, 1966- . Fellow, Royal Society of Canada, American Physical Society; member, Physical Society, Canadian Association of Physicists (past president), Sigma Xi. Research, publications on thermodynamics, especially specific heats of gases; nuclear physics, especially photonuclear reactions. Chairman, Science Council Committee on Scientific & Technical Information. Member, Science Council Committee on Physics & Chemistry. Member, Organizing Committee, 1969 International Conference on the Properties of Nuclear States, Montreal (Aug. 25-29, 1969).

Keen, M. J. Educated at Oxford University (B.A., Geology, 1957) and Cambridge University (Ph.D., Geophysics, 1961); Assistant Professor, Institute of Oceanography, Dalhousie University, 1961-1964; Associate Professor, 1964-1969; Professor and Chairman, Department of Geology, Dalhousie University, 1969-. Interested in marine geology and marine geophysics. Author of a number of scientific papers and one book, "Introduction to Marine Geology". Age 34.

Macdonald, John Barfoot. Born: February 23, 1918, Toronto, Ontario. 1942, D.D.S. University of Toronto (with honors); 1948, M.S. University of Illinois (Bacteriology); 1953, Ph.D., Columbia University (Bacteriology); 1955, F.A.C.D.; 1956, A.M., Harvard University (honorary); 1962, LL.D., University of Manitoba (honorary); 1965, F.I.C.D., (honorary); 1965, LL.D., Simon Fraser University (honorary); 1967, D.Sc., The University of British Columbia

(honorary). 1942-44, Lecturer, Preventive Dentistry, University of Toronto, and private practice; 1944-46, Canadian Dental Corps (released as Captain); 1946-47, Instructor, Bacteriology, University of Toronto, and private practice; 1947-48, Research Assistant, University of Illinois; 1948-49, Kellogg Fellow, and Canadian Dental Association Research Student, Columbia University; 1949-53, Assistant Professor of Bacteriology, University of Toronto; 1953-56, Associate Professor of Bacteriology, University of Toronto; 1953-56, Chairman, Division of Dental Research, University of Toronto; 1956, Professor of Bacteriology, University of Toronto; 1955-56, Consultant in Dental Education, University of British Columbia; 1956-62, Director, Forsyth Dental Infirmary; 1956-62, Professor of Microbiology, Harvard School of Dental Medicine; 1958-62, Consultant to Dental Medicine Section of Corporate Research, Division of Colgate-Palmolive Company; 1960-62, Director of Postdoctoral Studies, Harvard School of Dental Medicine; 1961-65, Member, Dental Study Section, National Institutes of Health; 1962, Consultant in Bacteriology, Forsyth Dental Infirmary; 1962-67, President, The University of British Columbia; 1962-67, Member of the Board, Banff School for Advanced Management; 1964-67, Member of the Board of Directors, Association of Universities and Colleges of Canada; 1966-67, Chairman of the Board, Banff School for Advanced Management; 1967, Consultant to the Donwood Foundation, Toronto; 1967-69, Consultant to the Science Council of Canada and the Canada Council on Support of Research in Canadian Universities; 1967, Chairman, Commission on Pharmaceutical Services, Canadian Pharmaceutical Association; 1968, Consultant, National Institutes of Health; 1968, Executive Vice-Chairman, Committee of Presidents of Universities of Ontario; 1968, Professor of Higher Education, University of Toronto; 1968, Consultant, Addiction Research Foundation, Toronto. 1949-54, Member, Canadian Dental Association Research Committee (Chairman 1951-54); 1949-52, Member, Ontario Dental Association Public Health Committee; 1950-60, Member, Canadian Research Council Committee on Dental Research (Chairman 1954-57); 1956, Member, Canadian Dental Association Research Committee; 1957-58, Member, Scientific Commission on Dental Research of the Federation Dentaire Internationale; 1958-62, Member, Advisory Board of Massachusetts Dental Hygienists Association; 1959-63, Member, Medical Advisory Board of Iran Foundation; 1963, Councillor-at-Large of the for Dental Research; 1958-61, Associate Editor of *Journal of Dental Research*; 1958-62 Regional Editor, *Archives of Oral Biology*; 1958-63, Editor, *International Series on Oral Biology*; 1962-63, Member, Honorary Editorial Advisory Board, *Archives of Oral Biology*; 1963, Consulting Editor, *Archives of Oral Biology*; 1968, President, International Association for Dental Research; Honor Award Key, University of Toronto, 1942. (President of Student Government Faculty of Dentistry 1941-42); Charles Tomes Lecturer, Royal College of Surgeons (Eng.) 1962. Memberships: International Association for Dental Research; Canadian Dental Association; New York Academy of Sciences; American Association for Advancement of Science; American Society of Microbiologists; Honorary Member, Harvard Odontological Society; Honorary Member, New England Dental Society; Honorary Fellow, American Academy of Dental Science; Canadian Council of Christians and Jews, Member, Pacific Region Board of Directors; Honorary Member, Vancouver Dental Society; Vancouver Board of Trade; The Men's Canadian Club of Vancouver. Honorary Offices: 1962, Honorary President, The Vancouver Intitute; 1963, Honorary Director, Muscular Dystrophy Association of Canada; 1963,

Honorary Vice-President, The Canadian Red Cross Society; 1963, Honorary President, Vancouver Public Aquarium Association; 1963, Honorary President, The University Club of Vancouver; 1963, Honorary President, Alumni Association of The University of British Columbia; 1964, Honorary Director, British Columbia Civil Liberties Association; 1964, Honorary Chairman, Vancouver Civic Unity Association; 1964, Convocation Founder, Simon Fraser University; 1965, Honorary Governor, Shawinigan Lake School; 1965, Member of Board of Honorary Governors, Canadian Association for Retarded Children. Married Liba Kucera: two sons (John Grant, Scott Arthur) and three daughters (Kaaren Campbell, Vivian Jane, Linda Rosemarie).

Madras, Samuel. Born and educated in Montreal Ph.D., McGill 1947. Joined faculty at Sir George 1948. Appointed to present post in 1963 after serving as Professor of Chemistry and Senior Professor in the Natural Sciences Division. Member of the Provincial Board of Higher Education 1964. Co-author of textbooks in Chemistry. Active in Professional Affairs in the Chemical Institute of Canada. Dean of the Faculty of Science, Sir George Williams University.

McCalla, Arthur G., B.Sc., M.Sc., Ph.D., F.R.S.C., F.A.I.C. Born, St. Catharines, Ontario, in 1906. Received the B.Sc., (Agriculture) in 1929 and the M.Sc. in 1931 from the University of Alberta, and the Ph.D. in 1933 from the University of California (Berkeley). From 1933 to 1939 was Research Assistant in the Department of Field Crops, University of Alberta. The year 1939-40 was spent on post-doctoral research at the Institute of Physical Chemistry, University of Uppsala, Sweden, working on the physical-chemical properties of wheat gluten. Appointed Sessional Lecturer at the University of Alberta for 1940-41; Professor of Field Crops in 1941; Professor and Head, Department of Plant Science 1944-51; Dean, Faculty of Agriculture, 1951-59 and Dean, Faculty of Graduate Studies, 1957-present. Fellow of the Royal Society of Canada and the Agricultural Institute of Canada. Member of the National Research Council of Canada 1950-56, and member of various N.R.C. committees for many years. Member of the Canadian Commonwealth Scholarship and Fellowship Committee since its inception in 1959. Research interests concerned principally with the study of the physical-chemical properties of plant proteins with special emphasis on wheat proteins.

McDougall David J. Degrees held: B.Sc., McGill University, 1948; M.Sc., McGill University, 1949; Ph.D., McGill University, 1952. Experience—Academic and/or Research in past 5 years: 1963-1967, Assoc. Prof. (and Dept. Chairman), Geotechnical Sc. Loyola College, Montreal; 1966-1967, (Sabbatical year) Research Scientist, Société Québécois d'Exploration Minière; 1967-1968, Professor (and Dept. Ch.) Geot. Sc., Loyola College; 1963-1968; Continuing research on thermoluminescence and allied solid state phenomena of geological materials, Author of numerous papers on thermoluminescence of minerals and rocks. Editor: "Thermoluminescence of Geological Material", (Academic Press) London. 1968. (Proceedings of N.A.T.O. Advanced Research Institute, Spoleto, Italy, 1966). Recipient of research grant from N.R.C., G.S.C., D.R.B.

Nicholls, Ralph, William. Born 1926, Richmond, Surrey England (Canadian Citizenship 1957) Married. Education and Degrees: Primary and Secondary Schools, Hove, Sussex, England; University of London, Imperial College;

A.R.C.S. (1st Class Hons., Physics) 1945, B.Sc. (Special Physics, 1st Class Honours) 1946; Ph.D. (Physics) 1951; D.Sc. (Spectroscopy) 1961; F. Inst. P. (1961). Academic Career: 1945-48, Senior Demonstrator, Astrophysics Imperial College; Department of Physics University of Western Ontario: 1948-50, Instructor; 1950-52, Lecturer; 1952-56, Assistant Professor; 1956-58 Associate Professor; 1958-63 Professor; 1963-65, Senior Professor; 1965-, Professor and Chairman of Physics Department, York University Director, Centre for Research in Experimental Space Science, York University. Visiting Appointments: 1959-60, Consultant, Heat Division (Free Radicals Spectroscopy (GS 14)) National Bureau of Standards; 1964, 1968; Visiting Professor of Aerophysics and Astrophysics, Department of Aeronautics and Astronautics, Stanford University Professional Activities International: Member International Astronomical Union; Member Commissions 14, 15, 29, 44, IAU; Member International Union of Geodesy and Geophysics; Member International Association of Aeronomy and Geomagnetism. National: 1954-, Member NRC Associate Committee on Plasma Physics; 1959, Member and Secretary Aeronomy Subcommittee of NRC Associate Committee on Geodesy and Geophysics; 1960-64, Member NRC Associate Committee for Space Research; 1959-60, Member NRC Associate Committee on Aeronautical Research; 1961-62, Councillor, Canadian Association of Physicists; 1960-61, Chairman, Lecture Committee, Canadian Association of Physicists; 1957-58, Member, National Committee for Canada of The International Astronomical Union; 1967-70, Member, National Committee for Canada of The International Astronomical Union. General: Associate Editor, Journal of Quantitative Spectroscopy and Radiative Transfer. Membership in Professional Societies: Fellow The Physical Society of London; Fellow The Institute of Physics; Fellow The Royal Astronomical Society; Fellow The Royal Astronomical Society of Canada. Member The Canadian Association of Physicists; Member The American Institute of Physics; Member The American Physical Society; Member The Optical Society of America; Member The American Geophysical Union; Member The Combustion Institute; Member The Canadian Association of University Teachers; Member The Canadian Research Management Association Consultancies (Current and Past): The Defence Research Board of Canada; The U.S. National Bureau of Standards, Washington, D.C.; Jet Propulsion Laboratory of The California Institute of Technology; Department of Astronomy, Harvard; Defence Systems Division, General Motors, Santa Barbara, California; Lockheed Missiles and Space Company, Palo Alto, California. Research Interests: Experimental and Theoretical Laboratory Astrophysics; Laboratory Aeronomy; Spectroscopy. General Information: Supervised over 20 Ph.D.'s and 25 M.Sc.'s; Over 120 papers published plus a number of unrefereed reports.

Publications: Intensity Measurements on Molecular Band Systems: A Method of Determining the Electronic Transition Moment for Diatomic Molecules, Canadian Journal of Physics 32, 515-521, 1954. P. A. Fraser. An Experimental Study of Band Intensities in the First Positive System of N_2 , I. Vibrational Transition Probabilities, Canadian Journal of Physics 32, 468-474, 1954, R. G. Turner and R. W. Nicholls. An Experimental Study of Band Intensities in the First Positive System of N_2 , II. The Transition Moment, Canadian Journal of Physics 32, 475-479, 1954, R. G. Turner and R. W. Nicholls. An Experimental Study of Band Intensities in the First Positive System of N_2 , III. Quantitative

Treatment of Eye Estimates, *Canadian Journal of Physics* 32, 722-725, 1954, R. W. Nicholls. Applications of Nuclear Coincidence Methods to Atomic Transitions in the Wavelength Range $\lambda\lambda$ 2000-6000Å, *Nature* 175, 810, 1955, Eric Brannen, F. R. Hunt, R. H. Adlington, R. W. Nicholls. The Interpretation of Intensity Distributions in the N_2 Second Positive and N^+ , First Negative Band Systems, *Journal of Atmospheric and Terrestrial Physics* 7, 101-105, 1955, L. V. Wallace and R. W. Nicholls. The Interpretation of Intensity Distributions in the CN Violet, C_2 Swan, OH Violet, and O_2 Schumann-Runge Band Systems by use of their r-Centroids and Franck-Condon Factors, *Proceedings of the Physical Society A* 69, 741-753, 1956, R. W. Nicholls. Molecular Band Intensities and Their Interpretation 'The Airglow and the Aurorae', Ed. A. Dalgarno, pp. 302-23 (Pergamon Press 1956), R. W. Nicholls. An Experimental Study of Band Intensities in the CN Red System *Canadian Journal of Physics* 36, 127-133, 1958, R. N. Dixon and R. W. Nicholls. Studies Upon Transition Probabilities and Molecular excitation, *Annales de Geophysique* 14, 208-224, 1958, R. W. Nicholls. Intensity Measurements on the O_2^+ Second Negative, CO Angstrom and Third Positive and NO Gamma and Beta Molecular Band Systems, *Proceedings of the Physical Society* 71, 957-964, 1958, D. Robinson and R. W. Nicholls. Intensity Measurements on Molecular Spectra and Their Evaluations, *Proceedings of the Fifth Meeting and Conference of the International Commission for Optics: Stockholm, August 1959, Paper No. 62, pp. 1-7*, R. W. Nicholls. The Interpretation of Intensity Distributions in the N_2 Lyman-Birge-Hopfield and CO Fourth Positive Systems, *Nature* 186, 958-959, 1960, R. W. Nicholls. Intensity Measurements on the CO^+ Comet Tail and BO α and β Molecular Band Systems, *Proceedings of the Physical Society* 75, 817-825, 1960, D. Robinson and R. W. Nicholls. Intensity Measurements in Emission on 29 Bands of the O_2 Schumann-Runge System, *Proceedings of the Physical Society* 78, 1024-1037, 1961, G. R. Hebert and R. W. Nicholls. The $\lambda 2763A$ (0, 9) Band of the O_2 Schumann-Runge System, *Journal of Atmospheric and Terrestrial Physics* 21, 213-215, 1961, G. R. Hebert and R. W. Nicholls. Intensity Measurements on Overlapped Bands, *Journal of Quantitative Spectroscopy and Radiative Transfer* 1, 76-87, 1961, D. Robinson and R. W. Nicholls. Radiative Properties of High Temperature Air, *Journal of Quantitative Spectroscopy and Radiative Transfer* 1, 143-162, 1961, B. H. Armstrong, J. Sokoloff, R. W. Nicholls, D. H. Holland and R. E. Meyerott. The Interpretation of Intensity Distributions in the N_2 Second Positive of N_2^+ First Negative Band System, *Journal of Atmospheric and Terrestrial Physics - Errata* 24, 749, 1962, L. V. Wallace and R. W. Nicholls. Allowed Transitions, Chapter 2 of 'Atomic and Molecular Processes' ed D. R. Bates (Academic Press, N.Y. 47-78, 1962), R. W. Nicholls and A. L. Stewart. Laboratory Astrophysics, *Journal of Quantitative Spectroscopy and Radiative Transfer* 2, 433-449, 1962, R. W. Nicholls. Intensity Measurements on Molecular Spectra, *Proceedings of International Symposium on Molecular Structure and Spectroscopy, Tokyo, September 1962 (4p.)*, R. W. Nicholls. Photoelectric Intensity Measurements Upon Bands of the SiN ($B^2\Sigma^+ - X^2\Sigma^+$) Spectrum, *Canadian Journal of Physics* 41, 240-245, 1963, Anne E. Stevens and H.I.S. Ferguson. Einstein A Coefficient, Oscillator Strengths and Absolute Band Strengths for the N_2 Second Positive and N_2^+ First Negative Band System, *J. of Atmospheric and Terr. Phys.* 25, 218, 1963, R. W. Nicholls. Transition Probabilities of Aeronomically Important Spectra, *Annales de Geophysique* 20, 144, 1964, R. W.

Nicholls. Absolute Band Strengths for the C_2 Swan System, *Proc. Phys. Soc.* **86**, 873-876, 1965, J. E. Mentall and R. W. Nicholls. Intensity Distribution of the Lyman-Birge-Hopfield System of N_2 , *Nature* **209**, 902, 1966, D. J. McEwen and R. W. Nicholls. Intensity Measurements in the Laboratory on the O_2 Herzberg $1(A^3\Sigma_u^+ - X^3\Sigma_g^-)$ Band System in an Oxygen — Argon Afterglow, *J. of Geophys. Res.* **71**, 3781-82, 1966, V. Degen and R. W. Nicholls. A Study of Emissivities and Transition Probabilities of Diatomic Molecules in Optically Thick Cases with Applications to the $B^3\Sigma - X^3\Sigma$ system of BeO, *J. of Quantitative Spectroscopy and Radiative Transfer* **7**, 639-659, 1967, G. W. F. Drake, D.C. Tyte and R. W. Nicholls. Relative Band Strengths of the A10 Blue-Green System, *J.Q.S.R.T.* (9, 1-11, 1969), C. Linton and R. W. Nicholls. Band Spectra of the singlet systems of the TiO Molecule, *Journal of Physics B(Proc. Phys. Soc.)* 1969 (In press), C. Linton and R. W. Nicholls. Intensity measurements on the O_2 Herzberg system, *Journal of Physics B(Proc. Phys. Soc.)* 1969 submitted, V. Degen and R. W. Nicholls, Aeronomically important transition probability data, (Proceedings of the 1968 IAGA Conference on Laboratory Studies of Aeronomical interest, York University, 1963), *Can. J. Chem.* (1969) In press. R. W. Nicholls.

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Postma, John F. Born October 14, 1926. The Hague, The Netherlands, in which country he received his elementary and secondary schooling as well as most of his undergraduate level university education. Came to Canada in 1951, did three years of graduate level work in theology at St. Augustine's College in Toronto, moved to Nelson, B.C. in 1954 to assume the post of Superintendent of Buildings and Grounds at Notre Dame University. Became a Canadian citizen in 1956. Earned a Master's degree in Philosophy from the University of Ottawa and a Master's degree in Political Science and Public Administration from Carleton University (1960-61; 1965-67), including graduate level work in the areas of sociology and law (administrative and constitutional). Versant in five languages. Over a decade of experience in university teaching in the departments of language, philosophy and education at Notre Dame University. Ten years administrative experience at this University in the positions of Superintendent of Buildings and Grounds, Bursar and Dean of Men (until 1965). In the Fall of 1967, appointed as Research and Liaison Officer for Academic Development. This has included work for this University in the area of administrative and academic structuring and planning, as well as work on 'briefs' submitted by Notre Dame to a variety of Commissions and Special Committees at the national and provincial level. In this capacity I have also represented the University at various meetings of an official or public nature. Has extensive experience in youth work and a 3-year experience in newspaper work as editor-in-chief and business manager of a weekly newspaper for the Southern Interior of British Columbia. Hobbies actively pursued include music, drawing and painting, snowskiing, waterskiing, fishing, tennis and hiking.

Robinson, G. de B. Born Toronto, 1906. B.A., University of Toronto, 1927. PhD.: Cambridge University, 1931. Department of Mathematics, University of Toronto: 1931. National Research Council: 1941-45. Visiting Professor, Michigan State University: 1952-53. Visiting Professor, University of British Columbia: 1963. Visiting Professor, University of Canterbury, Christchurch, N.Z.: 1968. Vice-President (Research), University of Toronto: 1965. F.R.S.C.: 1944. President, Section III: 1959-60; 1961-62. MBE: 1946. Managing Editor, Canadian Journal of Mathematics: 1949. Publications: 3 books and numerous papers. President, Can. Math. Congress 1953-57.

Young, Charles. Born December 4, 1933, Belfast, Northern Ireland. Marital Status: Married, one child. Position: Assistant Professor. Department: Physics. Institution: University of New Brunswick. Degrees and Qualifications: B.Sc., Queen's University, Belfast, Northern Ireland, 1955. M.Sc., University of Toronto, 1958. Ph.D., University of Michigan, 1964. Societies: American Meteorological Society. Canadian Meteorological Society. Canadian Association of Physicists. Member of National Research Council Subcommittee on Meteorology and Atmosphere Science. Academic and Research Experience: 1961-1964, Assistant Research Meteorologist, Department of Meteorology, University of Michigan; 1964-1965, Associate Research Meteorologist, Department of Aerospace Engineering, University of Michigan; 1965-1967, Assistant Professor, Department of Meteorology, University of Michigan; 1967-present, Assistant Professor, Department of Physics, University of New Brunswick. Number of Publications: Five.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, May 29, 1969

The Special Committee on Science Policy met this day at 3 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: I want to say that this has been, for the members of the committee, a great opportunity to have this so-called university week. I certainly hope that this will be a precedent and that out of this first experience a new relationship will be established between universities and the Canadian Senate. Although it may seem a bit paradoxical, since the Canadian Senate is viewed by many political scientists as an institution of the past, and universities are supposed to look to the future, and more and more towards the year 2000, I think that out of this first experience we have learned to know each other much better. I want to say that, as far as the Canadian Senate is concerned, as I intimated this morning, this is for us only a first phase of a continuing process.

We think that as budgets for science increase and as the role of science becomes more fertile, and as we move more and more to a situation when scientific discoveries will be transformed into new technology with all kinds of positive and negative effects and impacts on society, parliamentarians should also be involved in the process of elaborating and advising the Government on science policy and problems arising out of our national science efforts.

We have really enjoyed this week and we hope that, at some stage later on, this experience will be renewed, possibly with an even greater success, because we will have learned in the process to know each other better.

Perhaps before this meeting comes to an end, and since some of you have told us that you have learned from this experience and want now to add to your original briefs to

this committee, I should like to say again that the committee itself would welcome this. After all, we are a chamber of sober second thought, so that we would not be in a position to refuse your sober second thoughts after this kind of week of collective thinking.

As a former teacher, who in fact is still teaching, and because some of you did not seem to know some of the recent publications dealing with our subject, might I suggest to you, before you depart, a list of reading material published in Canada with special regard to various aspects of science policy?

I should like, first, to deal with a particular statistical study, both brief and rather elementary, and which was in a way the first time these figures were gathered together in an international context. I should like to mention here John Orr's study which is entitled *Statistical Data on Industrial Research and Development in Canada*. It is a series of tables which gathered a lot of figures up to the year 1965. Of course, I do not have to mention the most recent publication by the Macdonald group entitled *Special Study No. 7* issued by the Science Council and entitled *The Role of the Federal Government in Support of Research in Canadian Universities*.

There is also the *Special Study No. 8*, but I have with me only part 1 of that study, entitled *Scientific and Technical Information in Canada*. Here is another book entitled *Special Study No. 6, Background Studies in Science Policy Projections of R and D Manpower and Expenditure* by R. W. Jackson, D. W. Henderson and B. Leung. For those who are more interested in the problems of Canadian medical research, I would suggest a recent study published under the auspices of the Medical Research Council; it is entitled *Canadian Medical Research Survey and Outlook*. However, I do not even know if it is available for the public at the moment. Another book which has been issued by the National Research Council of Canada is entitled *Pro-*

jections of Manpower Resources and Research Funds 1968-1972. It might be interesting for those of you in special fields related to the National Research Council to read this to get an idea of the kind of grants you may receive in 1972. Finally, another study which has been issued under the authority of the Secretary of State is entitled *Federal Expenditures on Research and the Academic Community—1966-67, 1967-68.*

I do not want to make publicity for the committee here today, but if those of you who have not received the reports of our proceedings up to now would communicate with the secretary of our committee, Mr. Savoie, I am sure that the series can be made available. I am sure those of you who are on holidays will have the time to go through these 5,000 to 6,000 pages. When you have read all of this, you will perhaps be able to make a second or even a third addition to your briefs. I hope that this latest edition will reach us before our own report becomes public.

Again, I would like to say that we have enjoyed this week. I hope that all the universities that do not have a so-called research board will see to it that such a board or such a committee will be established very soon, and that the scope or the terms of reference of these boards will be extended so that teachers in each university will be afforded the opportunity to discuss, occasionally, not only their own research problems vis-a-vis the federal Government, but also, as I said this morning, the broadest use of science policy. I think that more and more science policy in our country will become, for all practical purposes, indivisible, in the sense that what goes on in industry will have to be considered in the light of what is happening in universities or in Government. I sincerely hope that as a result of our meetings this week we will see developments of this kind in our universities, so that as our own committee or another committee of the Senate continues reviewing Canada's science effort, we will be able to maintain continuing contact with you in order to obtain an over-all view, in so far as this is possible, of our country's total science effort. If we can achieve this, it will be most helpful to the Parliament of Canada, to our Canadian universities and to the future development of our country.

I hope you will forgive me for this speech. Now, we will come to order.

Honourable senators, I am happy to tell you that Dr. Macdonald and Dr. Dupré have been good enough to come back to Ottawa to be with us this afternoon.

Perhaps this afternoon will be a kind of free-for-all, because the committee members have had time to reflect on several of the recommendations of that study group. On the other hand, the committee may be rather passive and the proceedings will develop into a kind of seminar between our two guests and the academic community.

Now, Dr. Macdonald, would you like to say a few words to start with?

Dr. J. B. Macdonald, Executive Vice President, Committee of Presidents of Universities of Ontario: Thank you, Mr. Chairman. Honourable senators, I don't want to make any general comments this afternoon about the report itself. These appear in the proceedings of your meeting last week which we had the privilege of attending. So I think I need say little about that.

I would like, if I may have your indulgence, to comment upon your own opening remarks very briefly, and simply take the opportunity of speaking, I am sure, for the university community in applauding your suggestion, Mr. Chairman, that there be a continuing discussion between the Senate of Canada and the universities of Canada. I noted of course that you referred to the fact that some political scientist believed that the Senate of Canada is an institution of the past but I wish to assure you that academics in universities are very well acquainted with the problem of operating on senates that are institutions of the past, so it may put us both on exactly the same kind of a footing. At any rate, I do feel, and I am sure that the members of the academic community who are here this afternoon will agree, that continuing discussions between the Senate of Canada and the universities would be all to the good.

I would like to make just one comment before we are exposed in the hot seat to questions which may arise from those members of the academic community who are here this afternoon, and that is again in relation to your observation that the Parliament of Canada should be involved in these issues. This is central to our report. We feel, and I hope we have expressed clearly our view, that the goals of Canada are politically determined or should be politically determined and that the way in which science and technology can con-

tribute to those goals is a secondary decision. We need to know in the first instance what Canada is trying to do in agriculture, in urban affairs, in health, in transportation, in the quality of life in our cities and throughout our country.

Having some determination of what we are really after and having some judgments made by our politicians about what the priorities are, it is then not as difficult a matter to determine how science and technology can contribute to these individual goals. This is one of the reasons, one of the important reasons, why we place little faith in international comparisons of levels of research expenditure that are measured in such terms as dollars per unit on research and development in relation to Gross National Product. What really matters is how the expenditures in science and technology relate to the accomplishment of goals that are set out by the country.

The Chairman: Would you like to add something?

Dr. J. S. Dupré, Director of the Centre for Urban and Community Studies, University of Toronto: No, Mr. Chairman, I will be silent at this particular moment.

The Chairman: Who will shoot first?

Senator Cameron: Mr. Chairman, may I remind you just before we adjourned we said we would like to get something on the role of the computer. We have not had anything. Might we do this now and then go into the free-for-all? Dr. Hunka was going to make some comments.

The Chairman: I am sorry; I had forgotten.

Dr. S. Hunka, Division of Educational Research, University of Alberta: Mr. Chairman, I think that some of the discussion that has occurred here since Tuesday would indicate that any science policy that would not directly or indirectly support the development of computing power for Canada would certainly be a mistake. I am thinking here of computer power which not only involves the supportive equipment, the more standard type of equipment as we all know computers today, but also specialized equipment. And in addition here I would add what we refer to as software; that is the programs, the instructions that are given to the computer to carry out a particular and specialized activity.

I think it is rather obvious, and even the people in the street will realize, that the hori-

zon for computer applications has yet to be determined. Most will realize that the potential of the computer is established. We all realize here that we have a tremendously powerful tool.

I would suggest that at least at the university level it is extremely important to have this kind of computing power, particularly for purposes of staff recruitment. We find that people in chemistry, particularly those who come up from the United States, are very, very pleased to have access to computing power without having to account for every single dollar or minute that has been used on a computer.

I would therefore stress that there is the money that is required for the rental of the equipment, but there is also support needed in the development of certain computer programs, which we refer to as software. It is this software that can also provide the multi-discipline approach which is required to the solution of some problems. Programs that are constructed in mathematics become applicable in statistics which are used in the social sciences or in some of the other areas such as linguistics.

There are two areas which I think are becoming increasingly important and are related to other federal policies. One of these is the area of medicine and computer applications in medicine, and the other one of course is in the area of education. We have already previously heard someone mention here computerized instruction. The role of the computer in the hospital can lead not only to efficiency at the administrative level but also at the individualized level. For example, we know that at the Mayo Clinic work is being done on the analysis of electrocardiograms. It forms part of the information that a doctor uses for diagnostic work. We know that the records on patients, his past treatment, his current treatment, can be stored by the computer and used by the doctor to make better provisions for diagnostic work and therapy.

I think that that is one area where small innovative firms in Canada can develop. I think it was in Wednesday's *Globe and Mail* where a small company had its opening or establishment announced. Two members of that firm came from the University of Alberta and I know they got their initial computer experience there. These are the sort of software companies that can be devised. Again I

would point out here that risk capital is needed, not to be backed up by buildings or hardware, but we must have people who will put risk capital into human skills, into human brainpower.

I think also the computer will lead to a more efficient industrial complex, particularly when the computer is coupled with servo mechanisms for control purposes. We are a small nation. We have a small work force relative to the United States, but I think the computer does give us the chance here to provide an industrial complex which is far more efficient than we have had to date.

I think as to the instructional applications, and this is one that has been brought up before, we at the University of Alberta are working in the area of the instructional use of computers. We are in fact developing, for example, in the area of medicine, computer simulation of patient management problems where a medical student can in effect make his diagnostic errors by using the computer rather than the patient in real life.

We think this is a much more realistic type of situation for the medical student.

The Chairman: It certainly hurts less.

Dr. Hunka: It hurts less and costs less in the long run, Mr. Chairman.

Let me also say that I think the application of the computer can be made from kindergarten to continuing adult education. It provides the possibility of mass communication, mass learning for people. To illustrate that point, we know that the University of Illinois, for example, is devising a computing system with 3,000 terminals to be attached to it. We also know that in New York and Philadelphia terminal systems involving 200 terminals have already been installed.

Do not underestimate what the computer can do. If one goes back and looks at some of the predictions that have been made about computer applications, I think invariably you will find that they were underestimates by a very large degree.

The Chairman: Thank you very much. So now is it agreed that we will have the free-for-all? Please identify yourselves at all times.

Dr. R. W. Nicholls, Professor and Chairman of Physics Department, York University: I wanted, Mr. Chairman, to underline one of the things that has just been said. I wanted to

make four points, one of which I think is very important.

Speaking as a physics professor, I am very concerned about what happens to my product, the fellow or girl who gets a bachelor's or master's degree or a PhD. What sort of career will they have in Canada? It is a truism to say they can have a career in government science or they can have a career in university science. At the moment the career opportunities in industry in research or development are very small. There are a number of notable exceptions to this, but by and large, comparing the Canadian working environment for scientists to the United States, for example, or to many countries in Europe we find that the two places that people can be employed in Canada are in government and the universities.

We have a branch office business, a branch office industry, where we buy our technology from the United States and Europe. . .

The Chairman: Before you go on with this, this is not the first time this has been stated before us this week. What I want to recall here is that the Watkins Report, and I don't know if their conclusion was justified or not, or if there was statistical evidence on all this to justify their conclusion, but they were, so far as I can see, quite a responsible group, and their conclusion at that time was, insofar as research in Canada was done, the branch plant and foreign subsidiaries, compared with similar Canadian firms in the same fields, were doing as much, if not more, research in Canada than Canadian firms. If you have evidence against this, I am prepared to hear it.

Dr. Nicholls: I have been teaching physics in Canada for 21 years and more of my students, thank God, are teaching in high schools than are teaching in industry. Most of them are researching either in government, teaching in universities, or working in the United States. And I am very concerned about this.

To be brief, the suggestion I would like to make, which probably is full of holes, is that we cannot expect individual Canadian industries to set up expensive laboratories for development or research in their areas of technology; it is just too expensive. We might expect, however, consortia of firms, such as the pulp and paper industry, to set up research institutes. In fact, there is a pulp and paper institute.

There are many other areas, metallurgy in mining, applied optics, electronics, aerospace, and computers have just been mentioned. If each of the companies which is interested in a given area of technology could make a contribution, a membership fee to such a research institute, such institute might have 200 professionals and this fee could be a tax-deductible one. We could, right across Canada, have a respectable technological base where the products of the universities in the physical and life sciences could look for responsible and respectable careers.

With due respect to the comment you made, sir, it is not my experience that many physicists, in any case, go into industrial work in Canada. And I think that is a great pity.

That was my main point, Mr. Chairman. I have some other points but I think I will just leave it at that.

The Chairman: Could we concentrate on this particular issue for a moment? I will accept questions or answers on this point for about ten minutes, let us say.

Dr. J. Carroll, Department of Computer Science, University of Western Ontario: Mr. Chairman, I would like to agree with what the first witness mentioned with regard to computer applications and add a few more that seem pertinent to me. We have also the field of computer-aided design. Modern engineering design increasingly is being done, and will be done, by means of man-machine interaction using computer consoles. This is a possible field for computer application.

We have, as was mentioned, computer-aided instruction. I might point out that some of the particular problems the peculiar problems of Canada, particularly northern development, may be aided by this sort of assistance.

Information retrieval, we talked about network interchange of scientific and technical information. This is another important area of computer application.

Operations research in two denominations, operations research in connection with urban and regional planning and other government activities, and also operations research in connection with providing computer programs to improve management in Canadian plants.

All of this requires, as was mentioned, the development of software. A computer scientist does not sit down and write a program in

a vacuum. He must create his software and then he must de-bug it by actual or simulated operation on a computer.

We have a need for hardware evaluation. At present we have no indigenous Canadian computer industry. We purchase our computers from the United States, some from the United Kingdom and we may in the future be purchasing some from Japan. Whether we develop a Canadian computer hardware industry or not, I am not prepared to discuss right now, but at least we need a modicum of hardware development so that Canadian engineers are in a position to evaluate products that are being considered for purchase and provide advice to government and to industry. We need systems programmers or computer scientists who specialize in the interconnection of computer equipment.

Finally we have to investigate the use of computers or the role of computers in our new satellite projects. This again has particular relevance in the area of regional development within Canada. We can see, therefore, that there is a need for an infrastructure, for a body of professional technicians, the support personnel who will work with research scientists in this area, and the solution seems to beg for some sort of a government institute in this area.

The Chairman: Well, without reflecting on the last speaker, I would hope that we would try to cover as much ground as possible this afternoon, so that if interventions could be rather short, then we will be able to cover more ground than if they are too long.

Dr. C. Young, Assistant Professor of Physics, University of New Brunswick: I would like to endorse Professor Nicholls' statement about employment of specific students. This is particularly serious for graduate students in our experience. When they get their higher degree there are essentially very few places where they can get employment. The federal government, universities, and, as far as I know, only two industries in Canada employ them to any appreciable degree. I think that is a very serious situation. I think industry is going to have to expand, be more forward-thinking, have consortia—I think that is an excellent idea—so that we can keep our good physics leaders in Canada. This might not be so very serious in other fields, but it is very serious in physics.

Dr. Hunka: I would like to go back to what we initially started discussing. In this meeting

the last couple of days the idea of a national library system, a communications system which may be computer-based to bring to the attention of the researcher the relevant information in his field has been discussed, and I think the senators have the idea that perhaps some of the scientists were in fact not too impressed with this particular idea.

I think the article that Dr. McCalla made reference to indicates it is important for people at various levels, whether it is basic research, applied or developmental, to have access to crucial bits of information, like parts of a jigsaw puzzle that can be put together. However, I think what the scientists in Canada would be worried about in terms of a national library system is that they would be flooded by information which would take many hours to look at. We know that, for example, we can print out 1,500 lines a minute from a computer. What we really need is a selective dissemination system, a system that reflects the particular interests of a person and gives him only that information and not a mass of information that will take him several hours a day to try and go through.

The Chairman: Senator Grosart.

Senator Grosart: Mr. Chairman, I am particularly interested in the point that Senator Cameron has stressed on several occasions, and that is what the computer can do for us in terms of a national inventory of R & D projects in the wider sense of the word "projects".

You will recall when we were at MIT we asked about the status of their inventory and they said, "Oh, you cannot put this into a computer, there would be 500,000 items." And I think we were all surprised because we had all been told about the marvellous things computers could do, and I think it surprised us all that 500,000 items were beyond the capacity of the \$25 million worth of computers that we were standing amongst at the time.

Let us assume that the total number of projects that we would want to put together to make an inventory for Canada would be 50,000, which may be high or it may be low. What would be the capital and operating cost of programming, and the hardware aspects, of a computer to handle 50,000 reasonably good descriptions of what is going on, item by item, in R & D in Canada?

Dr. Hunka: Being used to the rental of equipment rather than purchase, I would estimate you would need probably between \$750,000 and \$1 million a year in rental. And then support personnel would cost perhaps an equal amount. I think technologically this kind of information can be stored in systems, that memory systems have been devised. I think some of the major problems, however, are the initial collection and sorting and preparation of the material and providing a continuous flow of the data from its original source into the system. The system, I think, in terms of what we can do with it, can handle the problem. There may be time elements here, that is, how fast do you want to get something out, and this to a large extent depends on how fast you can collect it from its initial source.

Senator Grosart: You would estimate about \$2 million a year to do the job on 50,000 descriptive items?

Dr. Hunka: I think you could perhaps do more than 50,000, depending on how much information on each one you would want to store. You could also use that computer for other purposes.

Dr. L. Barber, Vice President, University of Saskatchewan: Mr. Chairman, I would like to comment on Recommendation 22 in the Macdonald report relative to this discussion on computers. Recommendation 22 says that the present form of NRC grants to university computing centres be discontinued and that the computing information research be supported from the normal operating grants of all federal research councils. It is my feeling that the present form of grant structure has enabled computing facilities in Canadian universities to develop probably a great deal more rapidly than they otherwise would. This particular recommendation implies that we have reached a degree of maturity which allows us to stabilize the rate of growth at some level less than the present rate of growth. I would maintain that this would not be desirable at this instant of time and to withdraw the present form of grant to university computing facilities would be a dangerous step.

I appreciate the problem of rationing the existing time on the facilities which do exist and which will exist in the future but I think this goes too far in its approach to the rationing problem and that some intermediate step

is probably more desirable at the present time because I think that Canadian universities have been able to maintain a reasonable level of computing activity vis-a-vis their American counterparts, and to slow this down at this particular instant of time would be really quite undesirable. So I would suggest some intermediate form of rationing the available time but allowing block grants to enable universities to continue at a relatively high rate of growth in the addition of computing power and computing application.

The Chairman: Before I ask Dr. Macdonald to comment on this, I would like to have, in order to bring this specialized discussion to a close in due course, a couple of other comments.

Dr. M. J. Keen, Chairman, Geology Department, Dalhousie University: Sir, speaking to Item 22 of the Macdonald report I am not expert enough in the running of NRC funding to know which is the most sensible thing to do. Whatever is done it seems to be essential that universities be encouraged to centralize expensive facilities such as computer centres, machine shops, drafting, anything you like. I think Recommendation 22 could be a step against decentralization of computers in the university, which would be bad.

The Chairman: Other comment?

Dr. L. Katz, University of Saskatchewan: Mr. Chairman, in reply to the question raised by Senator Grosart, I would like to say that the background reports of the Tyas Committee which have not yet been published will contain an estimate of how much it does cost to put something on a computer. If I remember correctly, and I don't think there is any confidentiality at this time since the report has not yet been released, that is the figures, I think they estimate \$2 million...

The Chairman: Some say that everything that goes on in the Senate is secret anyway.

Dr. Katz: I understand that. I think it was \$2 million to put the information of a half a million holding library on computer tape. The experts may wish to question that figure. I am simply trying to quote from memory.

Senator Grosart: There seems to be a great difference between \$2 million for half a million items, and \$2 million for 50,000 items.

The Chairman: Well, you got a very quick estimate a few moments ago, and you didn't

pay very much for it. The Tyas study was more expensive.

Senator Grosart: You can see why I did not offer to pay more.

The Chairman: We will now hear what Dr. Macdonald has to say and if Dr. Dupré wants to add to that comment he may.

Dr. Macdonald: Mr. Chairman, I will make a comment or two about the question of computers, and I will start with the suggestion that Professor Barber has made about phasing proposal 22 or recommendation 22 in our report over a period of time.

We did in fact feel that computer development in Canada had reached the stage where it would be possible now to pay for service with real dollars and this would of course involve all the councils and not just the National Research Council, if one moved into this kind of a decision. But I think it is important to remember that there is a provincial element in the computer problem too. If I could use the example of Ontario as an illustration, it may help to make the point. I think it answers the other comment on centralization versus decentralization also.

In Ontario the government and the committee on university affairs have reached the point where they are providing the universities with funds for computer services which are incorporated within a basic income unit, and they have estimated a number of dollars per basic income unit which go to the university for that purpose. In short, they are saying that this is an operating cost from now on and not a capital cost and that the universities can organize themselves in respect to computers in any way they see fit.

As a matter of fact, the universities this year have agreed to centralize \$300,000 of their resources, their operating resources, for the purpose of a study of computer service for the whole system of 14 universities, with the expectation that there may be a sound case for moving to a very large facility to serve the whole 14 university system in which case there would be perhaps a development of a corporation operated by all 14 universities, operating a very large facility like an 85 with each of the universities paying on a pro rata basis into that facility.

So that converting to the payment of service by way of real dollars I don't think does have the effect of decentralizing and allowing

individual departments to obtain their own computer service in any way in which they see fit. The economics of it would make that unrealistic.

There may be a case for the phasing that you suggest and certainly we would not wish to see action taken by the councils to move to a position of funding computers only through research grants as an operating cost unless they were assured that there was sufficient progress made at this point that that was justified. I think that those that are involved in computer service in general in the country feel that this is the direction in which we should be moving and here it may be a question of timing.

Dr. A. G. McCalla, Dean, Faculty of Graduate Studies, University of Alberta: Mr. Chairman, this morning Senator Cameron said there was another item in which he was interested and which didn't get discussed at all. That is the number of times that universities have said that they do not want to see federal support for research handled through provincial governments. I think there was a feeling here and certainly in your own remarks this morning there was suggestion that this might be because of suspicion of the provincial government. However, I would like to submit that the main reason for this, Mr. Chairman, is that...

The Chairman: Well, in my case it was anyway.

Dr. McCalla: Yes, that if the funds were channelled through the facilities of the provincial government, then the selection of priorities rested with the provincial government whereas at the present time the selection of priorities rests with the university and the individual scholar. And I suggest to you that in the province of Alberta it would not only mean the provincial government, it would mean the university commission. And I am certainly inclined to think that we don't want to see this. We think that this could result in provincial interference in the decisions of federal bodies and therefore, so far as we are concerned, this phase of federal assistance, that is assistance in research by way of grants, contracts and what-not, must simply be a direct proposition between federal agencies and the universities.

The Chairman: Any other comments on this?

Dr. J. B. Hyne, Dean, Faculty of Graduate Studies, University of Calgary: Mr. Chairman, if I might just continue with these comments very briefly, I think that the really fundamental reason for ensuring that whatever mechanism is arrived at for the distribution of federal funds for the support of research in Canada in the university setting, that it must be direct, is that if this is not so, if I may be forgiven for saying so, then there is no such thing as a national science policy because to me a national science policy means that there is a policy that is good for the nation and presumably, at least under the present system of government we have in Canada, that body entrusted with national affairs is the federal government. Therefore the federal government must decide how much and where it is going to put its support dollars.

Dr. H. E. Duckworth, Vice-President, Academic, University of Manitoba: On this point, sir, as I understand the Macdonald report, the committee supports this point of view down the line except for the support of graduate students. There was some discussion this morning in which several university persons said that graduate students should be supported federally as well. However, I wonder if I am interpreting the Macdonald report correctly, that that is the only exception in the report to the federal support of research?

The Chairman: We will keep that for comment later.

Dr. Carroll: Mr. Chairman, with regard to the provincial study in Ontario on computing facilities, the preliminary report released by the people making the study showed that the computer that we could purchase with the money the province was going to make available was not an 85 but a 65, and, in the view of most of the users, the computing power that would be available in that machine would not be adequate.

The Chairman: Do you want to comment now?

Dr. Macdonald: With respect to Dr. Duckworth's question, Mr. Chairman, I think he is correct in suggesting that this is the only area in which we propose shared responsibility by the federal government and by the provinces. We do point out that the provinces do accept now, and we urge that they continue to accept, specific responsibilities that do relate

to research costs, salaries of academics, the cost of graduate education per se, and of course direct support of research which they choose to make to the universities. However, I believe that the area of graduate student support is one area where we suggested shared support on the basis of fiscal transfer. The reasons for it, I think, are elaborated and perhaps I need not go into them.

The Chairman: Another topic? What about the separation of the two functions of NRC? This is a free-for-all now. Some views have been expressed before this committee this week by some of the delegations that they were against separation. So I would like to have somebody now making the point again so that we can hear our two guests today speaking for it.

Senator Grosart: Saying to Dr. Macdonald's face what was said behind his back.

The Chairman: Yes.

Dr. Katz: I won't speak exactly against this recommendation, Mr. Chairman. I would like to bring to your attention the fact that both the grant support to the universities and the National Research Council are growing very rapidly. Their budgets are each now about \$60 million annually and in the next few years they will go up to \$100 million and maybe more. One wonders whether it would not be more efficient then to separate the two into two separated but closely related organizations.

I think we must look upon this not as something we are recommending for a surgical separation immediately but for a growth division, a slow division, a direction in which the National Research Council may be suggested to move. Rather than this coming from without, I think it might be something that has already started. The National Research Council has already appointed a separate vice president in charge of the university grants, and I think this is a step in the right direction.

Secondly, I think too many people have questioned the fact of the grants being associated with the National Research Council. I personally think it has been healthy. I wonder whether it has been similarly a healthy fact on the part of the National Research Council to have the responsibility of the grants. I think relieving the National Research Council from this responsibility

would leave them free to do many more things they could have done in other fields than if they had not been saddled with this responsibility. So I think in the long run I can certainly visualize this separation. In the short run I would be very disturbed if someone were to say, "Well, for next year this will happen". Therefore I personally feel if we looked upon this as the recommendation of a direction we ought to move in, an evolutionary process, I don't think there is anything wrong with the recommendation.

The Chairman: Well, I am afraid to repeat myself, but this is a kind of Jesuit approach to the problem again.

Dr. McCalla: Mr. Chairman, I would like to deal with it in a little broader context and deal with both the Canada Council and the National...

The Chairman: Well, these are two different problems.

Dr. McCalla: All right. Let me deal with the National Research Council. The reason I say this is because Dr. Hyne said this morning that he was afraid that if we had to reeducate another bunch of people to know that the universities didn't want to make them—that is very crude but nevertheless this is the implication—then he was afraid this would take too much time and we might better stick with what we had and which was working reasonably well. My own feeling is similar to Dr. Katz', that instead of saying that we cannot do any better we should have a good hard look and see if we couldn't do a lot better. I would be very much opposed to saying in the next fiscal year we are going to separate these functions. I think there should be a thorough discussion of this and we should come to conclusions, and university people should have something to say about how this is going to be run so we don't have to start in educating another bunch of people.

After all, NRC was not really set up to make grants to universities. This whole thing has grown, and it has grown to a magnitude which was never envisaged in the first place. I think that a good hard look should be taken at this. I think a lot that has been said about this is based on nostalgia rather than common sense.

Just to add a few remarks as to the Canada Council, I said this morning in a summary of our brief that we feel very definitely that the

Canada Council is not doing the job in its field that NRC and MRC are doing in their fields. So therefore I think it is only common sense that a means of getting this should be looked into. I said that you cannot have one group of people who are responsible for looking at grants for pre-doctoral fellowships in English and grants of \$100,000 for symphony orchestras and expect them to deal with both of these areas in an equal capacity. And therefore I support the Macdonald program in this regard.

Dr. R. E. Bell, Foster Radiation Laboratory, McGill University: I would like to repeat what we said yesterday, that we are against separation of the National Research Council granting function from its laboratory function except perhaps, as Dr. Katz says, over a very long period of time.

The Chairman: When you are retired.

Dr. Bell: Yes. This conclusion was also reached by the physics group in their Special Study No. 2 for the Science Council. They felt, and I think it is true, that the familiarity with research that the working scientist brings to the granting function is very valuable and that, in a word, to put the whole granting function into an office operation in effect would lose a very great deal.

The other point I want to make is that somewhere in the Macdonald report, and I have not succeeded in finding it in the last few minutes, it says that the question of separating the laboratory and granting functions of the NRC is similar to the question of separating the library arts function of the Canada Council from the research in humanities and social sciences, and I don't believe that is at all parallel. If that reasoning has the support of the Macdonald group in its earlier conclusion about the National Research Council, then I don't see the force of it.

The Chairman: Any other comments?

Dr. D. B. Currie, Vice President (Research), University of Saskatchewan: Mr. Chairman, I think in much of this discussion about separating the Council into two parts I cannot find anything with reference to the service which the National Research Council provides in many respects as a national academy of science dealing nationally and internationally. There are associate committees which bring

together university people, people from government laboratories and so on, on matters that are of international and national interest. For interest, there was the International Geophysical year, the International Biological Positivity studies and the Upper Mantle studies. And there were a number of these things in which I was involved because at the time I was chairman of one of the committees.

The Council does play a very important part there. For example, they can establish these committees, have university representation on them, and pay the transportation of professors to them, you see. Otherwise I don't know how professors could get there, although in these days of prosperity of universities they could maybe finance them.

The Chairman: They apparently got here this week and we are very happy about it.

Dr. Currie: Well, we expect to be paid by the universities. It seems to me this is something that must be looked at in this proposed separation. Is it something that would be attached to the laboratories or would it go with the National Research Council, or is it something that would be carried over to the Royal Society of Canada?

The Chairman: One last comment on this perhaps?

Dr. Nicholls: Mr. Chairman, from reading the proceedings of the meeting that your committee held with the National Research Council and from a somewhat cursory reading of the Macdonald report which I saw for the first time this morning, one gets the impression that the National Research Council has been under a bit of a cloud, that it has not been a good boy, that it has done pure research rather than applied research and maybe it shouldn't have this conflict of interest in looking at the university research grants when it is doing research.

I would like to say a word in very strong favour of the National Research Council. I think it is one of the ornaments of this country. I agree with Dean Currie. It is our national academy. A lot of the really first-rate world science done in Canada has been done in the National Research Council laboratories across the country. They are national laboratories. University scientists can work in them and vice versa.

I guess the point I want to make is that we should not overreact in a negative way to

some of the quite pointed questions that have gone on about NRC because we stand a very good chance of losing a real ornament of the Canadian scientific scene. I really have no firm opinion one way or the other as to whether the granting agency should be set up in a separate body except to say that if it were I would like to see all the granting agencies, NRC, MRC, the Canada Council and the rest of them as one unified granting agency by which common criteria were established.

However, the sort of inherent snide criticism of NRC that one has read in various articles over the last year saddens me a great deal. I feel that a lot of really first-rate people who have been giving Canada a tremendous reputation in the world outside are being quite wrongly criticized.

The Chairman: Dr. Macdonald.

Dr. Macdonald: Mr. Chairman, I would like to begin by commenting on the remarks of the last speaker, with which I fully agree. When you have had an opportunity to examine the report in more detail I think you will see that we do go out of our way to make a strong point about the distinguished history and performance of the National Research Council. The members of the study group are very much aware of the fact that science in Canada is the history of the National Research Council and what we have today is the result of the fine performance of the National Research Council over two generations.

This is, I think, one of the reasons why there is a great deal of emotion in some instances attached to our proposal to separate the laboratory function from the function of support of university research, and yet we don't see reasons for that. We can understand the emotion that is associated with it, but I think we react somewhat differently to this situation because we became also very keenly aware of the fact that the National Research Council has gone through an evolutionary process over its whole history. It has embraced in earlier years many functions which it does not now contain. The Defence Research Board is an offspring of the National Research Council. Atomic Energy of Canada Limited is something that grew out of the National Research Council. Medical research began in the National Research Council and had the status of an associate committee for a

period of time and then a division and then it finally became virtually autonomous in its present organization, a next door neighbour, but really virtually autonomous.

This is an evolutionary process and what we are suggesting is that the natural course of history in our country and the developments we have been seeing in science suggest that that evolutionary process should continue and we believe that whatever are the views that we hold or others may hold at the present time that evolution will continue and that sooner or later we will reach the point where such a division will take place.

The question has been raised by Dr. Katz of timing, as to when should such a division take place. We are making the proposal now because this happens to be the point in history when we have examined the issue, when we have been writing our report, and it seems to us that we have already grown to a point where it is a logical development to make the kind of recommendation which we have made.

I should say, Mr. Chairman, that if our information is correct there is a three-year backlog of legislation before the Parliament of Canada at the present time, so that there is no real likelihood of there being a surgical separation of these two functions during the next year.

The Chairman: It is moving much faster now.

Dr. Macdonald: I am very glad to hear that. I am sure everyone is. I think I should say a word or two about the reasons why we feel that the time has come or is near when such a division should be made.

First of all, we see an increasing divergence in the function of the operation of the laboratories and in the function of support of research in the universities. We see equally a divergence in the size of these functions. We are at a point now where there are 270,000 students in Canadian universities. It will be 540,000 by 1975, and there will be a corresponding growth in the size of the full-time faculty of Canadian universities with a corresponding increase in the demand for support for university research. We expect that the trends which have been evident in the last few years for very much more rapid growth in the universities support sector of the National Research Council's activities than in the laboratory function will continue

and that, whereas in the past year these two curves have crossed so that the support of universities is now a little larger than that of the laboratories, within another three to five years there will be a very great difference in the size of support, and this will favour the support of research in the universities.

That size alone is a reason why persons we have talked to who are close to the functions of the National Research Council feel that for purely administrative reasons there will be a demand for more and more separation. It becomes less and less practical to have full-time working scientists of the laboratories serving as convenors for review committees that are dealing with larger and larger numbers of applications, so this size factor, we feel, is an important one.

In addition, in respect to function, it is our view that one of the purposes of the laboratories should be to undertake tasks which are important to the nation, important to the government of Canada in relation to whatever fields the government itself may feel the laboratories should be devoted to, pollution, transportation, or any one of a very wide variety of choices and options that are open.

We know that the president of the Council himself feels that the laboratories should identify more clearly, more specifically, than they have been able to in recent years with certain tasks they can undertake, and that the laboratory scientists can be organized in groups to undertake applied tasks where the goals are expressed in terms of overall objectives for the laboratories rather than the objectives of the individual scientists. We see this as a divergence, an increasing divergence, in character compared to the role of support of research in universities.

We are convinced that the universities must remain the principal seat of basic research. This is not to say that the laboratories or any missions within government should not be conducting basic research. We know they must. However, that is what Brooks has called oriented basic research which is done because it relates in some way to the particular mission, although it may be just as fundamental as work done where there is no application in view. But we feel that the basic research which is conducted within the universities, and which always has been conducted within the universities, is an important goal in itself. For cultural, for educational reasons, and for the general quality and tenor

of life in Canada we do need to have as one of our goals the support of basic research. We think it important that people who are sympathetic to that particular goal be involved in the function of supporting research in the universities.

Relative to both of these comments, that of function and that of size, we feel that there already is need for full-time attention of people who are scientists, who are knowledgeable about the problems of science and of research, full-time attention to be given to the careful, thorough and critical adjudication of proposals coming before the National Research Council. We have no doubts in our minds, in spite of the distinguished history of the National Research Council, that that function can be much improved over what has been the experience of at least recent years. And we think that function will be improved in part by having the full-time attention of the Council to conducting this particular task.

Most of all, Mr. Chairman, we see the need for the National Research Council, and in fact, the Health Sciences Council, which is proposed, and the Humanities and Social Sciences Council, which is also proposed, to focus on the goal of strong universities as a Canadian goal in itself, quite apart from the goal or the multiple goals the government may have in many other areas, be they energy, atomic energy or health or whatever. It is important to have strong universities as partly a function of the government of Canada, and, because our universities are large and growing, we think it is important that there be agencies of the federal government who are devoted to seeing that there is strong research in Canadian universities and that there is balanced research in Canadian universities.

I must say, sir, that we would reject out of hand the proposal in the commentary on our report coming from the Canada Council which suggests that the Canada Council has no interest in universities as such but only in researches within universities. We think that is not the purpose or should not be the purpose of the Canada Council in relation to its support of research. We think that the future of the universities themselves is important and we believe that this position was supported in 1966 by a statement made by the then Prime Minister of Canada, the Honourable Mr. Lester Pearson, at the time that the federal government proposed the fiscal transfer arrangement.

Because we feel strongly that the support of university research per se is an important goal, we do recommend three agencies devoted fully and solely to that purpose. And if I were to try to dissect from the multiple reasons, some of which I have tried to develop here, the one we think most important as a background for our recommendation as to the division of the laboratory function from the support of university research, it would be that we feel that we must have in Canada agencies that are devoting themselves solely to the strengthening of research in Canadian universities and that these agencies, given the same status—we propose the status of agency corporations so that they are able to relate well to each other—and given arrangements for cooperation between each other, can best serve the purpose of the government of Canada in expressing its desire to have strong universities in this country without creating a constitutional conflict.

I think, Mr. Chairman, that is all I have to say.

The Chairman: Before I ask my colleagues to suggest other topics for discussion this afternoon, I would like perhaps to raise another one, and it is related again to one of your recommendations, recommendation 6, relating to the intercouncil coordinating committee which is a kind of follow-up to the subject we have just discussed.

In order to start the discussion about this I would perhaps ask Dr. Forward to speak on this because he had something to say this morning before us which, to my mind at least, was going further than this concept of the coordinating committee that we have here in this report.

Senator Cameron: May I just interject here, Mr. Chairman? For the guidance of other people as to the recommendations, it is a little thing but it is important, I like the way the Macdonald group made their recommendations and then put the page on which it is elaborated along with the recommendation. It is a very handy and simple device.

Dr. F. A. Forward, University of British Columbia: Mr. Chairman, were you thinking of my reference this morning?

The Chairman: You were speaking of something that would coordinate the activities of a certain number of councils like the councils which are suggested now by the Macdonald group.

Dr. Forward: This is exactly the kind of thing I had in mind, that there would be the three or whatever the number of councils may be, and then there would be a coordinating committee which would possibly be the committee through which the funds would be channelled to the councils. That is one concept. It may not be the exact one, but perhaps the councils could prepare their budgets, coordinate them through this committee, and this coordinating board or whatever you want to call it, they would be the ones who would present the budgets for these groups to the Treasury Board and through the Minister who would be the chairman of the Privy Council Committee.

The Chairman: But your concept of such a committee is a very tenuous one; it is just a kind of meeting of minds without any real power even of recommendation, if I remember correctly, Dr. Macdonald? I think what Dr. Forward had in mind, if I understood him correctly this morning, was something which was going a little bit beyond that with respect to these councils.

Dr. Macdonald: I think what Dr. Forward is suggesting, Mr. Chairman, is an alternative not to recommendation No. 6, being a council coordinating committee, but another recommendation, No. 10, a Canadian universities research advisory committee. We recommended a committee which would be set up to be advisory to Treasury Board on a confidential basis. We did consider the alternative which Dr. Forward has suggested, and that alternative was proposed to us in some of the briefs at the hearings which we held.

One of the reasons why we did not accept that particular solution was that we thought it important that each of the councils have direct access to government through a minister, that they be able to make their case. We felt that there are sufficient differences in the areas of science, the social sciences and humanities and health sciences, that council representatives should, as they have had in the past, have access to a minister where they could make their case. But this does not rule out the need on the part of Treasury Board to have advice on how it should divide the total pie that it is prepared to provide.

We see, for example, a situation where the councils might ask for X dollars, that is a total sum of X dollars between the three councils and then Treasury Board says to its

confidential advisers, "We simply cannot provide that much money. We can provide Y dollars. Given Y dollars, how should it be divided? Should it be a pro rata reduction or are the demands and needs of one council more urgent than that of another council?" And we think that kind of advice is the kind of advice which Treasury Board would welcome. As I mentioned last week, it is a fact that Treasury Board does get advice of this kind on an informal and confidential basis as it is now, as we understand it, and we are simply suggesting a means by which Treasury Board could get such advice on a confidential basis in a more formalized way.

Dr. Dupré may wish to add to that, Mr. Chairman.

The Chairman: Perhaps if you were to move this kind of secret operation, which I keep calling it, from Treasury Board to a kind of minister through which these councils would report, and these advisers would act as advisers to that minister, I would probably be more sympathetic to that proposal.

Dr. Macdonald: It if were one minister.

The Chairman: Yes, if it were one minister. Rather than seeing these people working in the secrecy of the confessional of the Treasury Board.

Dr. Dupré: But may I ask, under your scheme, Mr. Chairman, whether the minister himself would not sooner or later go to Treasury Board?

The Chairman: Oh, of course, but he would have his advisers. We always go to Treasury Board. Senator Robichaud was unfortunately in that position when he was Minister of Fisheries. And I was too. I was even a member of Treasury Board. And Senator Robichaud was one too. I think it would really be a kind of bad precedent to have outside advisers. I don't know of any precedent of this sort to have outside advisers advising Treasury Board on government operations. Of course the Treasury Board is always allowed to go anywhere seeking advice, and on another basis I am quite sure that this is acceptable but to have it in a systematic way I think would be a bad practice.

Dr. Forward: If I might try to clarify a point that I think is slightly confusing here, that is that I had marked No. 10, the Canadian universities research advisory committee, as "Yes, but why restrict it to uni-

versities?" my advisory committee involved not only the universities but industry and government agencies. And this is the confidential committee. It advises on all aspects of research. So we don't need a separate one, as it were, for the university sector.

The Chairman: Any comment on this?

Dr. Hyne: Not quite, Mr. Chairman, on this. However, I would like to comment on your original question about the intercouncil committee.

The Chairman: All right.

Dr. Hyne: I did make a remark about this this morning. If I might just elaborate on it now briefly, there are many reasons why on the intercouncil committee, irrespective of how many councils may emerge after the reorganization, there are many reasons why the intercouncil committee should exist, but there is a very important one that I don't think has been highlighted this afternoon, and that is that no matter how carefully this and other studies are done the group of men does not exist on this planet who can foresee all of the interdisciplinary and special topics that will develop in research in the future.

I think that the various research activities that receive federal support in this country have provided a sufficient number of meaningful examples in the recent past to leave us in no doubt that there are areas of research endeavour that are falling between the stools. Nobody can be blamed for it; we cannot be perfect. It would be my feeling that the inter-council committee, or whatever you care to call it, one of its prime functions would be to meet so many times a year in order to exchange views and in order to determine that no new area of research endeavour was being left out in the cold simply because of an organizational oversight.

The Chairman: How would you deal with research grants going to universities from other departments, from departments or Crown research agencies other than those three or more councils? Would they have to report or clear their activities with that committee?

Dr. Hyne: Well, it would seem to me, sir, that the intention would be that the Health Sciences Council, the National Research Council and the Humanities and Social

Sciences Council would be so structured as to attempt to cover a very large proportion of the fundamental research. The other government agencies would be presumably, shall I say, more mission-oriented in their approach. But certainly I would feel this intercouncil committee would have representation on it from the mission oriented supporting agencies, so that at least this would provide the overall Canadian forum in which problems of overlap and gaps and so on could be discussed.

Dr. Dupré: I was just wondering if it might be useful, Mr. Chairman, to give a little bit of background on our thinking relating to the Canadian university research advisory committee which, as you point out all too well, is alas indeed without precedent.

We found it very advisable to distinguish between the giving of information to decision-makers and the giving of advice to decision-makers. The giving of information to decision-makers was to us a somewhat broad concept that very much included the kind of information that any government agency brings before Treasury Board when it is trying to substantiate and defend its estimates. It was because we saw a very real need for this kind of information that is put to government when an agency, so to speak, is making its case, that we felt that individual councils should have some direct means of access to Treasury Board.

The Chairman: Well, they will have that access anyway provided the budget has been approved by the Minister.

Dr. Dupré: Yes. Well, at this stage let me perhaps say this, we did not go as far as what you suggest in terms of recommending that there be a single minister. Not least because we felt here that there was an area involved where perhaps other and more august decision-making bodies such as yourself might want to make representations. We were quite conscious, of course, as a study group of the kind of prime ministerial prerogative in a sense that is linked up with the assignment of responsibilities to ministers.

If I take your felicitous suggestion, sir, correctly that there might indeed be a single minister responsible to Parliament for all three councils I would hope that this would be consistent, as you have just pointed out, with perhaps a chance for each council to make its individual case because these cases do differ.

Going beyond the making of a case, Mr. Chairman, at this stage the question would arise, would the minister himself want some sort of independent advice, bearing in mind of course here that it is a really cardinal principle of science policy increasingly that advisory agencies should not also be operating agencies. At this juncture I submit perhaps as a thought that something like the Canadian university research advisory committee might well be a body which the minister perhaps rather than Treasury Board might want to turn to. However, I simply would try to uphold for the moment the notion that perhaps we should distinguish between providing information to decision-makers on the one hand with giving them broad general advice on the other.

An important input for information is the substantiation of a case for annual estimates. As to the advisory function, perhaps this is advice that Treasury Board might seek directly from a committee. On the other hand, the idea of providing advice to a decision-maker may still well be consistent with the idea of an individual minister.

Dr. G. W. B. Robinson, Vice President (Research), University of Toronto: I was interested in the suggestion of the possibility of a single minister. This is an idea which we have heard in the background of these discussions but just to make the connection with what my chief concern was yesterday, namely the granting of other departments, not through the councils, this is an area that really in our university has been found very complicated, and should the structure be established such as you have just thought of as a possibility and should the councils have a source of access to the minister and universities in relationship to the councils, it seems to me it would be essential that the activities of the various departments in the universities should somehow be involved. It can very well happen, if the change in our society persists, namely the emphasis on, well, take pollution as an example, that the relationship of pure and applied science might perhaps change in emphasis, but the role of the council might not be as dominant as it has been in the past. The growth of research through government departments might become increasingly important. This is my personal concern.

This role should be somehow integrated and related not only to what goes on in universities but related to the activities of those

same departments in their own laboratories. I put this to make the point that research cannot be split completely between what goes on in the universities and what goes on in the inhouse laboratories. I am very much concerned on this matter.

Dr. McCalla: Mr. Chairman, I just wanted to make a couple of comments. Certainly there is going to be more than one council. There has to be intercouncil coordination. The recommendation of the Macdonald committee is that this council be made up of the presidents of the three councils. It is the opinion of our group that this is too narrow and that at least there ought to be one member of each of the councils from the universities on such a coordinating committee. It is on page 107, Dr. Macdonald, right at the bottom.

As to the question raised by Dr. Robinson earlier, it seems to me that, although the changes that Dr. Robinson has indicated may very well take place, that the difference between the way of funding research might very well be the present difference between grants and contracts or grants and some other type of thing where the mission-oriented departments have a different kind of support.

Senator Grosart: Mr. Chairman, this discussion seems to me to raise what you would call the micro and the macro aspect of this problem of a coordinating, advisory or liaison body to feed the input of science into science policy, whether it be information or advice. I think it is more difficult to separate them than has been suggested.

The micro aspect has been discussed here, although nobody seems to worry about the NRC labs that the Macdonald Report assigns to task forces around the country. They are to be an agency, as I understand from recommendation 26, somehow under the direction of the Privy Council. So it seems to me that internally we would need a Laboratory Research Advisory Committee to bring the projected activities of the labs, somewhere into the picture, and a host of other Research Advisory Committees but surely they have to be brought together somewhere into a single information-processing and advice-giving body if the political system is going to work with a layman or a group of laymen, as far as science is concerned, making the decisions.

The macro aspect, of course, is that if we are going to have the Canadian Research Advisory committee and these others with a

back door to the Privy Council, to use your phrase, then of course it would have to allow industry to have an Industry Research Advisory Committee at the back door of the Treasury Board, and in the other performance sector, a Government Inhouse Research Advisory Committee, also at the back door. Then there would be, of course, the question of priorities,—who gets in first before all the money is spent.

I say this, Mr. Chairman, because the frustrating thing to me in the advice which has been so willingly and generously given by the universities seems to have completely bypassed the whole macro aspect of the problem. I am not criticizing this because it may well be that our own terms of reference to our witnesses may be responsible, but it is a surprising thing to me that when we are looking so desperately for this kind of advice we haven't received it from the universities. Surely the first place that we need to turn is the universities, and the first question we want to ask them is "How much, how big a piece of the pie do you think the universities should receive, of the R & D federal funding pie?"

Then surely we want to ask them—again I am talking from the viewpoint of political decision-making—what percentage of basic applied development funds should go into your university? We want this related to some kind of a survey of national science needs.

We don't have that kind of advice, and I suggest, Mr. Chairman, it is advice on these questions that we should plead with the universities to give us because we have so much conflicting evidence before us.

If I may quote very briefly, from one group, who gave us an excellent brief, but who are not here, the Canadian Association of Graduate Schools, who say, for example (and this just indicates the conflicting nature of the advice we are receiving):

The future role of the Humanities Research Council and the Social Sciences Research Council...

The Chairman: I think their absence is due to sickness.

Senator Grosart: I am merely stating they are not here.

The future role of the Humanities Research Council and the Social Sciences Research Council is not clear to us, but

we do not recommend that they have any major funding role.

Where do laymen go?

Dr. Macdonald: What council is that?

Senator Grosart: This is the Canadian Association of Graduate Schools.

Dr. Macdonald: What councils do not have a funding role?

Senator Grosart: The Humanities Research Council and the Social Sciences Research Council.

Dr. Macdonald: Well, these are non-governmental agencies which are now in existence.

Senator Grosart: They have very similar names to ones which have been suggested. That is really all I have to say on that point, Mr. Chairman, except to suggest that we might provide our friends from the universities with a questionnaire so that we could get some kind of a consensus on these things. For example...

Senator Carter: A poll, not a consensus.

Senator Grosart: Well, a poll. For example, again in what I call the Green Book, there is a recommendation:

We urgently recommend that there be a 35 per cent increase in the federal funds for university research and scholarship programs for the year 1970-71.

I think there is general agreement that there has to be greater funding in this area but if the figures that I recall from the evidence are correct the total federal funding of research and development in universities is about 10 per cent of the total, which is roughly \$100 million. If we apply this to the other two performance sectors the increase figure we get is very substantial. In other words, if we make a 35 per cent increase across the board it may be that we are coming up with the right figure, but could we? The information I am suggesting we should get from the universities is, as to this 35 per cent increase (or whatever it may be) is how do you relate it to the kind of increase there should be in the other performance sectors? Do you recommend the same for them? And again it would be most valuable to us to have views as to what the dimensions of the slice of the pie that should go into the university sector should be. This is a decision we have to face

ourselves if we are going to make a recommendation for a national science policy which will be that in fact as well as in name.

Dr. Macdonald: Could I comment on that, Mr. Chairman?

The Chairman: Well, I wonder if we could have some other comment on that before asking for yours.

Dr. Hyne: May I say first I am the president of the Association of Canadian Graduate Schools. Having said that, I have left myself wide open to Senator Grosart.

The Chairman: I hope you were consulted on the brief.

Dr. Hyne: Oh, yes.

Senator Grosart: I liked the brief very much.

Dr. Hyne: Although the Canadian Association of Graduate Schools is in fact an association of university organizations there was some confusion as to whether the brief was to be presented this week or not.

The Chairman: I was told that the leader of the delegation was sick.

Dr. Hyne: Mr. Chairman, my comments in respect to the remarks of Senator Grosart are these, and I think that reports from the Association of Universities and Colleges of Canada in 1966, I think it was, and again the Bladen Commission in 1967-68 did in fact produce some at least of the figures that the honourable senator is requesting, and indeed they were very frightening. In fact, some provincial governments have made it very clear that they are so frightened that they have absolutely no intention of providing anything like these amounts. 35 per cent, I think, is a figure that most people feel would not only provide the make-up money, but would probably take us into a slightly ahead position for the year quoted, 1970-71.

I think that it is the natural proclivity of man to ask for a somewhat larger part of the pie than he knows his digestive system can handle in the hope that after the various trimmings have been done he may get a piece that will sustain his existence.

The Chairman: This is well known in government departments.

Dr. Hyne: But I do feel to ask the university performing sector to make predictions as

to the size of the pie required by the other operating sectors, presumably industrial and government R & D, is asking the universities to be a little more generous in their predictions than they might otherwise be prepared to be because obviously every dollar they recommend for industry and government will come out of the same single pie dish from which they will be getting their slice.

Senator Grosart: May I interrupt to say that it is merely asking to be objective and scientific. This is what we expect from universities in a committee such as this.

Dr. Hyne: I think that is a point well taken, sir, but objective as we try to be in universities we nonetheless try to ensure that our slice of bread is well buttered before we start handing the plate over to someone else.

Senator Grosart: You still have not told us how much butter you want. It obviously affects the amount of butter the others are going to get.

Dr. Hyne: I think it is a very large task, sir. I do think the figures in the Bladen Commission, providing they are scaled up by the usual escalating cost of living and inflationary effect are still quite valid.

The Chairman: Any other comments on this? I wonder if we could have another short discussion, if you don't have any other topic to discuss?

Dr. Macdonald: Could I just make a comment first, Mr. Chairman?

The Chairman: Oh yes. I am sorry.

Dr. Macdonald: Senator Grosart, you referred to recommendation 26 at the outset of your remarks, and that was a recommendation that the federal government through the Privy Council office or some other appropriate central agency undertake a comprehensive study of government intramural laboratories, etcetera. I just wanted to clarify that that particular recommendation was not directed towards the National Research Council but all intramural government laboratories in all agencies and departments.

If I could make a very brief comment about Senator Grosart's remarks, Mr. Chairman, I would say simply that I think at least Dr. Dupré and I, who have gone through the exercise of trying to examine the university role, have great sympathy with the question which you are raising and with which this Senate Committee on Science Policy is con-

cerned. I think it would be presumptuous to try to present to you an off-the-cuff answer as to how we think this should be done. I don't think though, senator, that you are really asking us to tell you what percentage the universities should get of the total. You are asking us to say how should that percentage be determined, and that is really the problem. How does one get at the answer? What kind of machinery is required?

Senator Grosart: Excuse me. I should have said that I presume that will go on because there will always be an argument as to where you start in a system of political democracy between the first two priorities, that is whether you say the economy can afford so much or that the economy must put so much into R & D if we are going to stay in the S & T race. And the second priority is the need. You can argue forever as to what should come first. From a scientific point of view obviously you assess the need and say that this is what we must have. From the political point of view, if you are wise, if you are looking for money from government, you have to convince them they have to spend so much. Obviously the input into those decisions is going to be all your wisdom and your experience. I wouldn't want you to think I am suggesting that there shouldn't be very critical examination of the science needs in the university or the other sectors. Quite the contrary.

Dr. Macdonald: All sectors.

The Chairman: You see, we have not really begun. This is a new issue in Canada and in most other countries, I think, because we are just beginning to think in terms of some kind of an overall science budget. We have been told of course here by people that an overall science budget was nonsensical but I think most of the members of this committee do not share that view. We think it makes sense and the whole substance of our discussion now shows quite evidently that we must have some kind of concept of an overall science budget.

Dr. G. D. Cormack, Carleton University: In our brief yesterday we made a proposal about the formation of research institutes. I would like to repeat this because it seems to solve one problem that Senator Grosart has brought up about the three sectors. A large research institute system breaks down these boundaries between government people, between

industrial people, between university people. The Federal Republic of Germany has just started an institute system of the type that I believe would work in Canada. It would probably take many years to get such a system going in Canada but the long-term objective of such a system would be cheaper cost of research. It would avoid some of the fragmentation of effort that exists in universities today. It would provide some realistic direction to universities because they would then be able to work in conjunction with industry people and also government people would no longer find themselves sometimes off in the laboratory working on a problem that has no significance to anybody else in Canada. This has happened, as we all know, often in Canada.

The Chairman: We will have to send Senator Grosart to Germany.

Dr. D. J. McDougall, Department of Geotechnical Science, Loyola College: I was wondering, Mr. Chairman, if I could introduce a new subject? If there is anything else I will defer for the moment.

The Chairman: Is there anything on the same subject?

Dr. Bell: This is on the same one, Mr. Chairman. I just wanted to remark that for university people it is a little difficult to discuss their share of the total pie because it seems to be very much easier to find out what is being spent for Canadian universities from government than it is as to the government's or the industrial sector's expenditures.

The Chairman: For you perhaps.

Dr. Bell: It is easier to get information from the government about universities than it is to get information from the government about the government in this field.

Senator Grosart: We are not so sure about that.

The Chairman: We will ask Dr. Forward to answer this because he has been in both.

Dr. Forward: Well, Mr. Chairman, I believe it is quite easy to find out what the government spends on science. The Dominion Bureau of Statistics puts out this figure every year or every couple of years. There is a statement of the amount that is spent on research and development in every government department and in every discipline.

The Chairman: And each agency has to publish an annual report about its activities.

Dr. Forward: It is all in the government accounts.

The Chairman: Perhaps you have too many figures.

Dr. Bell: Perhaps as to the whole amount that they spend and even broken down by departments, but what they are actually doing with it is not so easy.

The Chairman: Oh, you mean the output, not the input?

Dr. Bell: For instance, to take a concrete example, in the physics report, Special Study No. 2, in one of the sub-reports, which is on nuclear physics, the list there of the accelerators in Canada omitted at least three accelerators that were in government labs and of which that sub-committee had no evidence at the time it made up its report. It is not easy to hide an accelerator.

Dr. Macdonald: Apparently it is.

The Chairman: Missing accelerators.

Senator Grosart: Maybe they were in universities.

The Chairman: Any other comments on this?

Dr. Michael D. B. Burt, Department of Biology, University of New Brunswick: Mr. Chairman, there is one point here that concerns the interdisciplinary nature that I think perhaps is brought out in some of the briefs, but which has not been, I feel, stressed sufficiently, and that is at the coordination level of grant-giving because it happens, as I understand, fairly frequently that a grant which is made, or a grant application which is made to one particular granting body, if it does not meet with the approval of that body, can be dropped. My point here is that it could very well meet with the approval of another body, and I would like the Senate Committee to consider some kind of possible way of passing such grant applications, where they don't fit into one particular niche, perhaps on to another niche.

I am thinking now, just to be specific, about the Medical Research Council, for example, and the National Research Council. If there were some sort of a common application form, that would help. This I know is going right down to the micro level, if Sena-

tor Grosart would forgive me for a moment, but this is where the actual money is coming to the people who are going to be doing the work, and I think this is where a certain number of these people are deeply concerned. If there was some kind of common form, then it may be that there could be some transfer of applications if they do not happen to fit a particular niche. This is just coordination of the different levels that I think might be attained.

The Chairman: Anything on this same subject?

Dr. Samuel Madras, Dean, Faculty of Science, Sir George Williams University: Yes. It seems to me one needs to ask another question of the macro type in order to be able to answer how this pie is going to be cut up. It matters very much whether the funding committee is interested and concerned with the purpose of research that goes on in the country. If they are, then the slicing will go one way. If, on the other hand, they believe that the ultimate authority is the individual researcher and nobody shall tamper with his decisions and his purpose, then of course the decision goes the other way. The struggle becomes more or less a free-for-all.

The Chairman: I wonder if at the university level now, and it may be a complicated thing to do, but if universities are tending to project their needs in the field of research, let us say, on a period of five years, for instance, trying to forecast their needs, as government agencies have to do now?

Dr. Madras: They are doing that more and more. However, I think the other question too as to what is their objective in the research applies. Is it still the individual researcher's idea of what he is going to do and only that?

The Chairman: Well, I think we are dealing now more and more with a variety of possible assistance to various undertakings in universities. We are speaking now of supporting free research. We are speaking of strategic grants and various things. At some stage there must be some kind of projection of needs at the individual university level as well as more or less the local level.

Dr. W. A. Bridgeo, Dean, Faculty of Science, Saint Mary's University, Halifax, Nova Scotia: Mr. Chairman, in an attempt to check some information requested by Senator Grosart, I would like to ask where universi-

ties have offices of research administration, if they have formed a set of goals or aims for research in their institution, and if they have it, would this be a suitable administrative means of collecting information and bringing goals together to higher bodies?

Dr. Forward: Well, Mr. Chairman, like some others in the room, my job at the University of British Columbia is as a consultant in administration. We believe that does not involve setting goals for the university. The goals are set by the people in the departments, the faculties, the research people, the individuals themselves.

The Chairman: But as a result each individual in a university has goals. I wonder if it would be possible to organize a process whereby the individual goals in a university could be added up?

Dr. Forward: Well, you bring them together, yes, and certainly it is the function of the university research administration to look at the broader aspects of it and if there are discrepancies or imbalances, as we pointed out, I think, in our own brief, if there are imbalances in respect of money spent on research you bring this to the attention of the university authorities and the people in the university and try to urge them to go ahead and do something about it.

Senator Cameron: Mr. Chairman, there is my inventory again.

Dr. Forward: If I could say a word there, I think one of the first things that is done in the science sector is an effort to find out where you are going. As I see it, you cannot jump across the stream unless you know where you are standing and how wide the stream is. That has been the basis of the information collected for all of these studies, and which is still going on.

The Chairman: But what worried us about this is that your study of the plant inventory in physics was published when? Two years ago?

Dr. Forward: Three years ago.

The Chairman: And the inventory is not finished yet in other disciplines. When we come back to physics it may be ten years from now.

Senator Grosart: NRC were very annoyed with us, Mr. Chairman, because we had the temerity to ask how many projects they had going.

Dr. Nicholls: Mr. Chairman, there is one day-to-day problem that faces the university researcher which may in part answer the question that you asked. I think most of the individual researchers and the collaborating teams of researchers have their own five-year hoped-for plan. In five years, if we are addressing ourselves to a given problem, we would hope at a reasonable rate of growth to do this or that.

However, sir, and this is not to be interpreted as a criticism of the granting agencies except in one matter of detail, most of us have to live with annual research grants because the fiscal arrangements of the country are based on an annual financial year. This means that one hears about one's grants, say, by the 1st of April. You can make commitments to students, you work very hard during the summer. By the beginning of September or October you are preparing your application for next year's grant, and there is a great deal of bookkeeping, which is really quite low level as intellectual exercise but is necessary to the scheme in order to carry on. By next March you may know what your grant will be. It may be less than you reasonably hoped for. And then you have to make a major policy decision on how you change what you hoped to do that year to fit in with the amount of money available.

I realize we are not unique in this economic situation. Everybody has to live from year to year. However, if one has sort of a five-year dream, there is not really much good talking about it if this is continually modulated by an annual granting procedure.

I don't know whether this is within the terms of reference of your question, sir, but I would certainly make a plea for a return to one model that the National Research Council had a few years ago of a three-year grant whereby you knew at least a guaranteed minimum level of support for a three-year period, particularly for experienced investigators. With that sort of guarantee, subject of course to approval of the funds by Parliament, I think reasonable predictions at least on a three to five-year basis can be made, but as long as we are tied into an annual grant application procedure it is extremely difficult to make meaningful estimates.

Dr. Hyne: I think I would be doing Dr. Macdonald a disservice not to deal with recommendation 44 at this point, which I

endorse, and the University of Calgary endorses whole-heartedly. It recommends a three-year granting period.

I would just like to make one further contribution regarding the question of the universities planning their research ahead. I believe that any university in Canada that has availed itself of the opportunity to apply for, and hopefully be awarded, a negotiated development grant over the last two or three years has been forced by virtue of the terms of that award to do exactly this, to look at least five years ahead because one of the requirements of the negotiated development grant was that the university commit itself to the continuation of this particular project on rather a large scale.

It would seem to me, sir, while I shudder a little at the thought of group grants, major proposals, negotiated development grants and strategic development grants, I do feel that some consolidation of that terminology could be achieved, and that. . .

The Chairman: I call it the "opportunity" grant.

Dr. Hyne: That would be No. 5 then, sir. The exercise of universities going into the business of examining how they get into this program would in fact perhaps answer Senator Grosart's need for the assurance that universities were in fact looking forward in terms of their research and development.

Senator Grosart: Mr. Chairman, I am not greatly concerned with that really. If I may make my meaning clear, I would put it this way, by saying that I think a good dietitian would say that the first thing to determine about a pie is its relation to the nutritional requirements of the family. It means relating the ingredients of the pie to those nutritional needs. Then you have to decide the size of the pie that each member of the family gets, hoping they won't all grow to the same size or to the same weight at the same time. But you have to have the pie before you can cut it up.

The Chairman: You would make a very good cook, I think.

We had from Loyola a proposal to change the subject, I think.

Dr. McDougall: Again I am in the position of only having acquired this Macdonald report this morning so I am not very conversant with it, but my impression has been that the smaller universities and colleges may be left some place behind. As far as I can gather

from what has been said in past and from what little I have been able to get out of the report, the big universities' research programs will get bigger and be centres of excellence and the smaller ones may be left somewhere at the rear. I am not sure whether that is correct or not.

The Chairman: Would you like to comment on that?

Dr. Dupré: I might just comment, Mr. Chairman, that we have recommended that all three research councils make use of strategic development grants whose purpose is precisely to help the universities that have certain problems of size or certain peculiar problems associated with the region they are in or with the fact that they are English or French-speaking. In recommending that all three councils have a specific category of grants to be made available for universities with these kinds of problems we are trying to...

The Chairman: You are proposing to deal with excellence and with relevance.

Dr. Dupré: Yes. We are trying to remedy precisely the sort of situation that the questioner raises.

The Chairman: Would you like to speak to that? This has been raised before, it has been more or less a theme throughout the week.

Dr. Macdonald: I would just like to emphasize that we do not see anything contradictory or incompatible in using the terms "excellence" and "relevance" at the same time. We don't see anything wrong with adjudicating proposals for strategic development grants on a basis of merit and interpreting the term "merit" not only as a means of examining the intrinsic worth of the proposal itself but also its relevance to the whole development of a balanced program of research in Canada.

The Chairman: Yes, Dr. Katz.

Dr. Katz: Mr. Chairman, this morning when we were remarking excellence and relevance Dr. Bell mentioned to me there is one other aspect and that is the aspect of competence, and that is the development grant, to build up competence. I think we should have a third one.

The Chairman: I think this problem was raised also by various people, including the

University of New Brunswick. I wonder if you want to ask further questions on this problem from the maritimes?

Dr. Burt: If I might say one thing here, Mr. Chairman, and that is that again it comes back to this interdisciplinary thing. I feel that some of the smaller universities can benefit far more than some of the larger universities by combining their own intrinsic talents with those talents that might be available in the vicinity, in the particular region in which they happen to be, and that perhaps one of the best ways of administering such assistance would be to provide certain grants which could be sort of handled by not simply one institution but which had perhaps two hands to the grant, where the university and the government institution perhaps both had to be participating or where industry and government or where industry and the university were concerned, as the case may be. But to give it all to one, it might in that way allow that particular group to develop whichever way they want whereas to tie it down in the same way as some of the perhaps Fisheries Research Board grants I think are now tied down, I think this would be one particular way of solving this problem.

Dr. Bridgeo: I would like to make one final comment on that, Mr. Chairman. I think that the avenue of the president's grant at the moment is the best way of handling the situation in the small university. That is one that does not have a graduate program or a very small graduate program. If the strategic development grants were to take the place of the president's grants later on, I think it would be simply a matter of time—but make them big enough.

Dr. McDougall: I might just add this comment, that I think at this point we have now initiated some basis for discussion with some of the people in some of the smaller places around Montreal to try to see if we can work together.

Senator Carter: Mr. Chairman, it is getting late in the day but we have had a lot of talk here the last few days about advice. All the briefs practically from universities, the ones I have read, certainly have implied that the government has not been getting the best of advice in the way the grants have been apportioned or the way the science effort has been allocated. I got the impression from

what I heard listening that a lot of this advice comes from bodies on which the universities themselves are represented, so this bad advice, if it is bad advice, can be traced back to the universities themselves. I am wondering, before they go, if they want to say a word in their own defence?

The Chairman: Well, you are aware perhaps, Senator Carter, that Dr. Forward this morning was asking for more representation from universities on boards.

Dr. Forward: I still don't think universities are that fully represented.

Senator Cameron: Mr. Chairman, we have had quite a session over the week. We have had a lot of information thrown at us in a rather dispersed form. I think that Dr. MacDonald is to be congratulated in getting off so easily this afternoon. I had the impression he might not.

However, I think one of the things that is obvious to me is that there are gaps in the information we want, particularly at the policy formulation level. I am wondering if it wouldn't be desirable for our committee to draft a questionnaire, as was referred to earlier, because we know where the gaps are. The group sitting around here may not be as familiar with these gaps.

If we could get out a questionnaire which would list the areas in which we would like to have more specific information than we have at the present time, and this need not be a long questionnaire, but it is one to which we would like to have specific answers from the widest possible cross-section of the university community. I think this might save time. It might help us in formulating our recommendations which will be coming up very shortly. I think in fairness to the university people if we posed specific questions to them in the light of the thinking they have done, in the light of the presentations they have made, we may help them and we may help ourselves. So I am going to suggest we prepare this questionnaire and send it out as quickly as possible.

The Chairman: The only problem is that they will have to work during the summer months and a lot of these university teachers may not be at their universities.

Senator Cameron: I would say you must get it out within the next two weeks so that they can get a reply back.

The Chairman: If you can find some time during the next two weeks, Senator Cameron, to prepare that questionnaire, you will be doing very well.

Dr. J. F. Postma, Research and Liaison Officer for Academic Development, Notre Dame University, Nelson, B.C.: On that particular point, Mr. Chairman, I for one certainly intend to go home and try to piece together some of the usable details that have been thrown out over the last few days into one coherent pattern. I just wondered how much time can we allow ourselves to do this kind of work? What are your deadlines? Have you set yourself a deadline as a committee?

The Chairman: No, but I think it would be very useful for us to have these views sent to us as early as possible. Let us say that we would hope to get these views not later than the middle of July, and I think rather than send a questionnaire, I think the idea in principle is a very good one, Senator Cameron, but I am afraid the delays in our own staff or in us preparing a questionnaire, because of the busy month that we have ahead, that that would pose problems. I am sure that we have been talking and discussing all week with the elite, the intellectual elite, of this country, and I am sure they know pretty well what is worrying us at the moment, after having been exposed to our questions and our discussions, so I hope we won't have to send that questionnaire.

Senator Carter: Mr. Chairman, didn't you suggest that they might consolidate or make a summary of what has gone on this week and let us have it back?

The Chairman: I suggested that right at the beginning of the meeting this afternoon, and also alluded to it this morning because some of our guests here this week have suggested that they might want to add to their briefs, and I told them privately and I told them publicly that any suggestions or any additions coming from them would be most welcome by the members of the committee. I think this is a more practical and a quicker way of communication than for us to prepare a questionnaire and then send it along and we would not be sure even that it would reach you before September. And so, I want to repeat again that any suggestion along our lines of interest that you can send us will be most welcome.

Senator Grosart: Mr. Chairman, I would like to support the suggestion made by Senator Cameron. I don't think the questionnaire is such a great problem, particularly if it were limited more or less to the macro area where we have not had too much of the benefit of the thinking of people in universities. I repeat that there is nobody more qualified, such as the members of the Macdonald study group, to come up with some answers to these macro questions. I am sure the universities could respond. It wouldn't take them much time. It wouldn't take us much time to make such a questionnaire. It might include some of the questions I have raised today.

Mr. Chairman: Obviously they know the questions now. If you want a sub-committee of our committee to prepare a questionnaire I would be delighted to send it, but as far as I am concerned in the coming few days or few weeks I certainly won't have time to work on this, and I think it would be futile to develop this idea and not come forward with it.

Senator Grosart: Maybe we should leave it to the steering committee, Mr. Chairman, where you are outnumbered.

Dr. Paul Hagen, Doyen des Études supérieures, University of Ottawa: It seems to me, Mr. Chairman, there is one important point that would have to be considered in deciding, first of all, what the size of the pie should be relative to the Gross National Product and how much of the pie goes to government, industry and universities, and to what extent university-industry cooperation is important and to what extent this should be encouraged by financial means of other kinds. It would seem to me there must be some way of getting some information about this. In the first place, a man these days tends to ignore and not make use of his past, but surely there must be a number of precedents one could look at, for instance at the growth of physics and chemistry in Germany in the first half of this century, and one could see what sort of particular policies had been developed, what were the sources of finances, how much of it went for the finances, how much of the finances that were available were devoted to university research, doctoral research, government research, and so on. What is going on in Switzerland at the moment? How has Japan managed to achieve a fairly prosperous economy? Is research important in this? To what extent is research important? To what

extent has it played a part in the development of the economy and the growth of industry in the economic growth of the country? To what extent are the failure in the British distribution of their large amounts of funds, second only to the Americans, responsible for the prevailing stagnation of the country? Where were mistakes made?

By comparing these it may well be possible to get some idea as to what is the best way, what one might think would be the best way to distribute our funds to develop the encouragement of science in the country. I was wondering if this committee had done something about that?

The Chairman: I think this academic community that we have seen this week has various experience and various backgrounds and so that is why I think it would be a good thing if rather than cover the whole waterfront, for instance, you, having special knowledge of what goes on in various countries in which there is an interest, could make your contribution along those lines, and others who have another background might do a similar exercise, so that instead of trying to work along similar lines we would try to work along complementary lines. I would certainly welcome that kind of exercise.

Senator Carter: Mr. Chairman, if they are going to do that I would certainly like to have some submissions on particular lines. I like this idea about research institutes. One of the points that has been stressed over and over again is the difficulty as to where you draw the line between what is basic and what is applied. When we were down in Boston I think we found that more and more mission-oriented research is interdisciplinary. There is more than one discipline, several disciplines, involved in this work. And it seemed to me that a research institute would offer possibilities along that line. It may be that it is one way of solving these problems. We haven't got any very clear answers up until now.

Senator Grosart: A case in point is a statement in the last report of the Science Council that they have not been able to discover a relationship between R and D expenditures and national productivity. It may be difficult. We can assume there is a relationship from the history of other countries. I would go so far as to say that if we don't find out what that relationship is we are not going to have a national science policy.

The Chairman: Well, I would qualify that statement a little bit, but substantially I think it will be very difficult to develop a correlation between current expenditures on R and D and the current growth of Gross National Product, because if we try to do this, and this is the kind of comparison, for instance, which was included in John Orr's study, we are comparing things which are not comparable.

Current research and development expenditures will have their impact. We were told this morning that basic science might have some practical results thirty years hence. We were told by Professor Marquis at Boston that technological transfers may take us on the average about eight years. So if we are trying to compare current expenditures on research and current Gross National Product we will never find any kind of relationship.

Senator Grosart: I wasn't suggesting that, but actually you are defining the relationship in the statement you just made. It may be that there are time lags and the relationship may be long-term. These are the kinds of questions to which we must come up with some answers—what is the relationship. If there is no relationship, then we might as well give up trying to define a national science policy. We also have to decide what is the relationship of basic as against applied research and development, to national productivity. It may be a very long-term projection, but it has to be done, in my view.

Senator Carter: Wouldn't you say this, that while there might be a relationship, and there must be, that it is not necessarily that important because in the case of Japan where they have concentrated on innovation rather than like other countries doing basic research, they just wanted the ideas and innovated on the products of research of other countries?

The Chairman: I think, senator, you could write a wonderful economic history of Great Britain just starting with the development of the steam engine.

Senator Grosart: You could write a very good history of modern Japan starting with the transistor.

Dr. Katz: I think, Mr. Chairman, adding to this discussion, not only is there this long-term relationship between research and innovation but there was a study a few years ago in the United States called Operation Hind-sight where they attempted to delineate the

major components of a practical program that had been carried out and innovated, and I think this was within the Department of Defence, where they thought they could identify the various components in each project. The surprising thing there was that most of the components contributing to the success of the project were solved after the project had been funded, not before.

As a matter of fact, in a similar vein, at one time I understand that airplanes on the drawing board were being designed to take off with engines which had not yet been designed or built, hoping that by the time this airplane had been constructed and was on the runway there would be an engine to lift it. So I think this is a multi-dimensional problem, and I don't think we can have a simple long-term or short-term relationship. It depends upon the desire to innovate, the desire to put your reputation and your money on the line and say, "We are going to build this." And then I think you will find the solutions to the problems.

So on the one side you need to train people. On the other side you need industry which is bold and imaginative. And I think the relationship between the two is very tenuous because it involves an integrated involvement over a long period of history taking in right up to the moment you decide to go ahead.

The Chairman: Coming back to Senator Grosart's point of a moment ago, it is one of the goals at least of a science policy to see that the lag between scientific discoveries and technological developments and innovations gets shorter and shorter, so that we will have a high degree of correlation between research and development and Gross National Product over a shorter period of time.

Senator Grosart: Which brings us back to where you started: How much federal funding should go into basic science? How much into applied? How much into development? How much into universities? How much into inhouse? And how much into the industrial sector? You are back with the same questions, I suggest, Mr. Chairman, that as a committee we have to answer.

The Chairman: Well, we will try. I think we will have to finish this very interesting exercise soon. I have to catch a plane to Quebec City to make another speech tomorrow.

Dr. Carroll: On the Japanese question, I don't think we can say they are entirely imitators at the present time.

The Chairman: They were.

Dr. Carroll: We have seen things, a lot of good creative work, over there that is just beginning to bear fruit, and I think we will see more of it in the future. I think Japan presents an excellent pattern for government feeding of research on a national scale.

The Chairman: Thank you very much. Other questions?

Senator Grosart: Mr. Chairman, can I wind up my comments with another quotation from the brief of the Canadian Association of Graduate Schools?

The Chairman: You really like it, eh?

Senator Grosart: It again indicates the conflict of views in these briefs:

This brief discusses the role of the universities in research, and puts forward the view that most, but not all, pure research should be done in a university setting, and most, but not all, university research should be free of specific applied goals.

Dr. Forward: It was not written by an engineer.

The Chairman: Well, ladies and gentlemen, thank you very much for having accepted our invitation. As I said earlier, this is our first meeting. I certainly hope, on behalf of the members of the committee, that this will not be the last.

The meeting adjourned.

APPENDIX 93

BRIEF

BY THE

CANADIAN ASSOCIATION OF GRADUATE SCHOOLS

PRESENTED TO

THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF

THE SENATE OF CANADA

MARCH 1969

I. The Association

1. The Canadian Association of Graduate Schools (CAGS) is a national organization made up of deans from the graduate schools of Canadian universities. It is affiliated with the AUCC. It represents all major graduate schools in Canada. The decision to present this brief was taken at the annual meeting in Ottawa, November 4 and 5, 1968; the brief has been approved by the executive committee. The officers of the Association for 1968-69 are: Dean R. J. Rossiter, University of Western Ontario, president; Dean J. B. Hyne, University of Calgary, vice-president; Associate Dean B. N. Moyls, University of British Columbia, secretary-treasurer.

2. Graduate studies and research within universities are so intimately interwoven as to be almost inextricable. The science undertakings of our country are operated by the products of the graduate schools. Consequently, almost any topic of interest to the Senate Committee is of interest to our Association, and it has been difficult to determine the topics for discussion in this brief. We have selected four major areas for comment, but if a delegation should present the brief it would be prepared to respond to questions from senators on other topics. The four major areas are distribution of responsibility for research of various kinds, cooperation and coordination amongst universities, granting policy, graduate student enrolment and support.

II. Summary

3. This brief discusses the role of the universities in research, and puts forward the view that most, but not all, pure research should be done in a university setting and most, but not all, university research should be free of specific applied goals. We discuss the very real concern over an over-emphasis on mission-oriented research and stress the danger that a neglect of basic research will destroy Canada's scientific stature and may lead to a scientific community very unbalanced in terms of distributions between disciplines and fields of expertise. We comment on the severe effects of the current hold-the-line budget and recommend substantial increase for 1970-71.

4. The brief discusses the cooperative use of resources and coordination of future development within groups of universities and describes developments in Ontario. It discusses both the advantages of such coordination and the problems it produces, including that of providing research opportunities to persons without graduate students. We emphasize the need for federal agencies to be aware of such planning.

5. We reassert our belief that most research grants should come from federal sources and should be based on excellence. We discuss the provincial role in research support. We discuss the problem of overhead in grants and contracts. We discuss the role of different agencies and government departments in research and express our belief that most of the diversity and flexibility in research funding can be best handled by institutional grants to universities as a supplement to those to individual research workers. We discuss whether, in deciding on grant support, emphasis should be given to the ability of the applicant or the value of the project. We see virtues in both, and stress the need for continuing unfettered grants.

6. The brief discusses briefly the reliability of forecasts of the production of Ph.D.'s and their employment prospects and comments on the desirability of a wider employment of Ph.D.'s and on the possibility of providing a wider training for them. We discuss the dangers of doing anything very decisive to restrict enrolment on the basis of employment projections, even if they should prove reliable. We discuss the support of Canadian students abroad and of foreign students here. Finally we make a remark on the desirability of continuing to include a student support component in research grants.

7. Recommendations

(i) We urgently recommend that there be a 35% increase in the federal funds for university research and scholarship programs for the year 1970-71.

(ii) We recommend that universities should identify and interpret their distinctive roles in education, research, and community service and to cooperate with other institutions of higher education and governmental agencies thereby ensuring a coherent effort, serving the economic, social and cultural development of provincial and national communities, employing scarce resources

most effectively.

(iii) We recommend that granting agencies support research in small universities (or departments not doing advanced graduate work) sufficiently to provide on a continuing basis technical assistants and services necessary for efficient research. This recommendation is made in the context of the existence of university cooperation and research coordination.

(iv) We recommend that granting policies be such as to encourage the development of centres of excellence, possibly embracing more than one university.

(v) We recommend the development of liaison between federal granting agencies and the regional and provincial groups involved in research coordination.

(vi) We recommend that for each field of study there be one principal federal agency to which university staff would apply for support for pure research. (N.R.C., M.R.C. and Canada Council play this role.) We recommend that other federal departments should support primarily applied research.

(vii) We recommend that each university be provided with funds for research, to provide support for worthy projects which for one reason or another cannot be funded within the policies of the federal agencies, e.g. special support for particularly promising younger staff members, unusual projects, unforeseen projects, etc. It is suggested that these funds should be from the federal government.

(viii) We recommend that the policy of unfettered grants to university researchers be continued and expanded.

(ix) We recommend that any Ministry of Science Policy have no operational responsibility for the administration of research grants.

(x) We recommend that no drastic action be taken to limit Ph.D. enrolment in certain fields on the basis of employment projections.

(xi) We recommend that scholarships to Canadians should be tenable outside Canada only in exceptional cases where there are inadequate facilities in Canada for the particular field of study or where some most exceptional student has the opportunity to work with a very distinguished scholar.

(xii) We recommend that provision be made for the support from Canadian sources of a reasonable quota of foreign students.

III. Distribution of Responsibility for Research

8. The purposes of government in supporting research within universities would seem to fall into two categories:

(a) the general advancement of learning and knowledge, the patronage of established scholars and the development and maturing of young scholars, on the assumption that these things are for the common good in an advanced civilization and that if Canada is to play the role its citizens would like it to play in world culture, these things are necessary;

(b) work on specific problems or in specific areas where the results are of immediate significance either to the Government itself or to Canadian industry, trade, health or welfare.

9. How can the universities respond to these purposes? The universities have two primary functions -- the education of students and the development of scholars on the one hand, and the advancement of knowledge on the other. These are the universities' traditional roles. A third role has become steadily more apparent in this century, namely service to the community in solving specific problems by bringing to bear on them the expert knowledge available within the university. Often this takes the form of consulting by staff members, and unpaid work on a multiplicity of advisory committees at all levels of government but it also involves contract research or direct service, as in medicine.

10. How does research contribute to these ends? It is self-evident that research advances knowledge, and one may therefore expect to find faculty members engaged in research and that their activity need have no direct connection with students. But also, research does bear significantly on the educational facet of the university's task. Research is an indispensable part of the training of the young scholar, and therefore those who supervise Ph.D. students must be active in research. Moreover, the most lively and current undergraduate instruction usually comes from a man who is actively pursuing advanced scholarly work, which is usually, but not always, research.

11. Reasons similar to these also provide an academic argument for applied research within the university. To be a good teacher of engineers, medical practitioners, or economists, it is necessary to be engaged oneself in the problems one's students will face. Therefore, appropriate consulting or contract research is desirable. It is also needed to train the graduate student

in a number of areas; it is, for example, valuable training for the budding design engineer to work on a "real" problem, in which some prospect exists for the evaluation of the student's performance in terms of practical results.

12. We believe that the intellectual life of the country is stronger if most of the pure research is done in universities and industrial and governmental laboratories concentrate on applied research and development. There is at present a distortion of this desideratum: many government laboratories do considerable fundamental research which might be better done in a university environment. This remark should not be construed as a criticism of past actions, for when NRC and AECL, for example, began to develop fundamental research sections it would have been very difficult to have created anything on the same scale within the universities. Some of the applied research currently in government departments should be in industry; there is need for more applied research also in universities but this need can be supplied by net additional work rather than by relocation of present work.

13. There is a place for some pure research in government laboratories. No large laboratory with practical goals can perform its mission well unless, amongst the mission-oriented scientists, there is a leaven of good uncommitted scientists of wide knowledge and experience to advise and stimulate. These latter people must do pure research; it matters rather little what it is as long as it is within the same general area of interest as the practical work of the agency. We believe this to be the justifiable extent of intramural pure research in government laboratories such as NRC, DRB, Department of Agriculture, etc.

14. The situation in the Social Sciences is similar but at a different stage in development. It is obvious that research surveys and the like have to be undertaken from time to time by some government departments, Finance for instance. But the amount of pure research that will or should be undertaken is bound to differ very widely from one department to another. Any research undertaken by the Department of Finance is likely to be directed to immediately practical ends, whereas many of the studies which the Department of Northern Affairs makes of our Eskimo and Indian populations could probably be regarded as pure research.

15. Quantitative research in the Social Sciences costs increasingly large sums to pursue; and it is most desirable that this pure kind of research, when conducted outside of governmental agencies, should not be impeded owing to lack of the necessary financial support.

16. It will be seen then that the CAGS supports the resolution passed at the Centennial Conference of the AUCC that

"the AUCC continue to encourage its members to pay primary attention to the development of research policies which relate to the universities' responsibilities for teaching and enlarging the body of knowledge, but at the same time to remember that emphasis should also be placed on mission-oriented research projects which are in the national interest."

17. That said however, it is essential to record the very real concern in the university community over the current emphasis given to the concept of mission-oriented research. It is true that the Science Council's Report No. 4, whose title optimistically suggests that it is pointing Towards a National Science Policy, does contain several reminders of the need for support of basic research, and it is true that Dr. Solandt at the meeting of the Special Committee on November 6, 1968 did say that we should not forget "what we have called here 'Little Science', curiosity-directed research" (p.945, Proceedings of the Special Committee on Science Policy). But these gentle reminders of the worth of new knowledge are rather lost in the vigorous support in the Report for certain quite specific mission fields and in the emphasis given in Dr. Solandt's other remarks on November 6 to a science policy which "must be concerned far more with how we use science to solve social and economic problems, rather than with how we develop science". This attitude has caused a good deal of consternation among those active researchers in Canada who prefer to call themselves fundamental scientists and social scientists. Indeed, the phrases "Little Science", "curiosity-directed research", far from conveying reassurance, tend to raise the fear that if basic research is seen in these terms the financial provisions for it will be contained in "Little Budgets", suitable for running Olde Curiositie Shoppes. In our enthusiasm to direct our research efforts more toward the tackling of current real social and economic problems let us not forget that the reason we can even consider mustering any research potential for this task is that we have in the past two decades recognized the importance of establishing a strong cadre of fundamental researchers, some

of whom can now turn their efforts to mission-oriented research. Our ability to make outstanding contributions to the technological effort in World War II was related to the reservoir of broadly trained research personnel in every facet of science which existed in the Canadian universities and in the government and industrial laboratories.

18. From the viewpoint of university research and training it appears difficult to reconcile a national science policy which has specific objectives with the needs of the country for broadly trained persons in health, agriculture, mining, forestry, oceanography, metallurgy, biology, economics, sociology, and all the branches of engineering, medicine, and other disciplines. We believe that care should be taken in defining national science policy to insure that the basic needs of the country are not neglected in order to direct a disproportionately large part of our national effort to a few specific goals. This is not an argument against the need for an emphasis on specific objectives but a plea that the primary needs be met before costly programs are endorsed. We have a great need in Canada for a variety of non-mission linked activities in the universities to provide a fundamental base for any mission-oriented projects supported by government. These more expensive undertakings usually require a large expenditure of time and a continuity of effort by individuals working as a large team. They have a limited use in training scientists, engineers and social scientists in fundamentals and they have a limited adaptability to graduate programs.

19. Perhaps the most essential element of science policy from the university point of view is to ensure that the tradition of scholarship is maintained. We cannot hope to achieve greatness and attract the best minds to this country unless we can develop outstanding scholars in the various specialties. The development of scholarship requires that we encourage the best people to become experts, give them opportunity to exercise their talents and recognize their achievements in Canada.

20. It follows then that, if the government now proposes to provide funds to allow us to come to grips with some of the specific problems that retard our economy, we will be making a significant advance. If, however, the increased support for mission-oriented research is to be achieved by a

redistribution of funds, and a retardation of present work, Canadian science will be in a truly precarious position.

21. The funds available to NRC for university support for 1969-70 justify pessimism on this score, a pessimism deepened by the rumour that there is to be no increase for 1970-71. There are already marked effects of the frugality in 1969-70. The National Research Council had no increase in funds for its scholarship support program; since the number of students on continuing awards has been increasing each year, this implies that fewer new awards can be made. On the basis of preliminary information, we estimate that the proportion of this year's graduate classes beginning graduate study under NRC scholarships will be reduced by about one-sixth. This affects the future of Canadian science at its most vulnerable point, the decision made by the new graduate of our universities as to his career -- in science or out of it, in Canada or elsewhere.

22. A similar effect will be seen in the NRC research grants to faculty members. At the time of writing this brief, the awards have been decided but not announced. Consequently our information is only fragmentary, and unofficial, but we have no doubt that the per capita grant is reduced, not just in purchasing power but in dollar amount. This will cause a substantial slow-down in basic research. To continue the situation for a second year would be extremely harmful. Apparently Canada Council has been able to avoid quite such a serious situation in its support of the social sciences, but the funds available from it have not increased as rapidly as they should for healthy development of research in the growing university departments.

23. We urgently recommend that there be a 35% increase in the federal funds for university research and scholarship programs for the year 1970-71. A greater percentage increase would, of course, be necessary to restore the loss in growth sustained this year, but 35% is suggested as a realistic figure.

IV. Cooperation and Coordination of University Research

24. At its meeting on March 13, 1968 with Professor V.W. Bladen, the Senate Committee dealt briefly with the problem of the division of responsibility between universities for areas of study at the graduate level (p. 86-87). This is an increasingly significant question, for the very rapid

proliferation of universities and of sizable departments within older universities is necessitating cooperation. No one of the provinces could afford to contemplate fully grown graduate schools in all disciplines on all campuses; there would be insufficient human resources, let alone financial. Undesirable duplication must be avoided (some duplication is justified) and rational development must be planned.

25. The problem is acute in Ontario with its fourteen provincially supported universities. In 1965-66, the Spinks commission studied graduate development in the province and made substantial recommendations. As a first step, the universities agreed to submit all proposals for new graduate programs for academic appraisal by an Appraisals Committee of the Ontario Council on Graduate Studies. The universities have also adopted the position that all library material of a research kind is a provincial resource; one now speaks of the Ontario Universities Library System. Rapid inter-library loan has been achieved by telex and regular stationwagon routes between the university cities. Each library has opened its services to faculty and graduate students of the other universities. Rapid strides are being taken towards a unified Bibliographic Centre. Duplication of research library collections will be prevented or undertaken only where necessary. The departmental chairmen of each academic discipline are beginning to plan the future growth of their subject, and decide on allocations of areas of specialization to each university. The result will be diversification; in any given subject there will be institutions offering only bachelor's or master's degrees, and others offering doctoral work in chosen fields of concentration.

26. This kind of pattern is becoming evident in the other provinces also. It carries with it certain problems and certain opportunities. On the positive side, much greater strength arises from shared use of resources; a centre of excellence may develop instead of several centres of gray mediocrity in pointless competition. Fields not previously covered may become active research areas due to conscious planning. One of the problems is the difficulty of providing research opportunities for members of the staffs of departments without advanced students. It is important to overcome this difficulty, for the man who has no interest in the current problems of his discipline soon ceases

to be a good teacher of undergraduates -- and, incidentally, the need of the teacher to synthesize and present the current understanding often introduces the faculty member to new insights and ideas for research. The scientist or scholar without graduate students needs facilities for personal research. The universities with established doctoral programs can help here by encouraging cooperative arrangements, and the researcher's own institution can provide technicians or postdoctoral fellows. Some resources in addition to the normal grants are needed. We support an AUCC resolution that

granting agencies support research in small universities
(or departments not doing advanced graduate work)
sufficiently to provide on a continuing basis technical
assistants and services necessary for efficient research.

27. Need it be added that on the other hand, we strongly support the development of "centres of excellence"?

28. Besides coordination of their research efforts, there is certain to be much more in the way of inter-university cooperation. Libraries have already been mentioned, and there are many other examples, some involving cooperation with government agencies and industry.

29. This trend to cooperation and coordination is also supported by an AUCC resolution urging universities to

identify and interpret their distinctive roles in
education, research, and community service and to
cooperate with other institutions of higher education
and governmental agencies thereby ensuring a coherent
effort, serving the economic, social and cultural
development of provincial and national communities,
employing scarce resources most effectively.

30. Inter-university cooperation is, of course, mostly organized on a regional or provincial basis. It is clear then that decisions are being taken which profoundly affect science policy without much involvement of national scientific bodies. There is need for formal and continuing consultation between national planners and provincial and regional planners. As we emphasize in the next section, the provincial contributions to research funding are extremely significant. A national policy may be frustrated if it ignores the realities of inter-university planning. At present there is essentially no formal liaison; it must be developed.

31. In summary, inter-university cooperation is seen to have great potential as a method for providing simultaneously both economy in use of resources and considerable strengthening in the level of activity and quality of research in the universities.

V. Granting Policy

32. We believe that the major direct support for university research projects should come from the federal government. In many fields, Canada has human and financial resources for only a very few centres of emphasis in any one specialty. Thus, about half a dozen or so major nuclear accelerators and a limited number of centres of linguistics have to look after the needs of all of Canada in their respective disciplines. For this reason, the major sources of research funding should be national.

33. At the level of individual research grants, there will usually be more contenders for support in a given field than the country's resources can sustain. We believe strongly that the primary yardstick for the funding of a particular worker or project should be the quality of his work. This quality should be assessed on the international scale by scholars competent to apply such standards. Clearly such comparisons should be made in a nation-wide context.

34. It is also important that the universities in the economically weaker provinces have the possibility of obtaining research funds from the federal government. Otherwise, since research, although one of the most essential, is one of the most expensive aspects of a university's many undertakings, there is the risk that it would be de-emphasized with disastrous results for the general standard of the universities in these provinces.

35. The provincial governments also are properly involved in supporting research in a very significant way. They provide much of the direct costs of research through professors' salaries and students' scholarships and almost all of the overhead costs which are carried in university operating budgets and in capital grants for buildings. The federal agencies have up to the present very seldom supported buildings needed to house federally supported University research. Neither do they contribute to overhead costs. CAGS is on record as supporting the recommendations of the Bladen report on overhead, but further comment at this time is not felt to be appropriate.

36. Research contracts proffered to university departments by industry or by government departments for the solution of a specific problem will frequently be attractive, particularly to the professional faculties, since they will assist the very necessary university-industry-government dialogue.

There seems no reason why the federal agency or industry should expect the provinces to support contract research, and we suggest that legitimate overhead charges (100%) be paid to the universities on contracts.

37. The provinces should also give research grants which complement the federal arrangements. It seems likely that research directed to special provincial needs or the development of special provincial resources will always be a provincial responsibility to a large extent. But the other gaps the provinces may cover will vary from time to time. For example, Ontario is stressing the support of the new junior faculty member and has provided graduate fellowships in large numbers in the arts: both are long standing needs which should be met by the federal government (the enlarged program of Canada Council is welcome but does not yet eliminate the need for provincially funded fellowships).

38. There are a large number of federal agencies playing some role in university research, but there are three principal ones: NRC, MRC, and the Canada Council. In many fields this presents a monolithic structure in that there is precisely one place to go for research funds. Some comments on the desirability of this are in order.

If it is assumed that national objectives in research can be defined and kept under review and if it is assumed that a large organization can work efficiently, then it seems reasonable that there be only one principal federal agency for each field. Having said that, one must hasten to insert the qualifications.

39. In science we recommend that the principal agency be NRC or MRC as appropriate, but we note that the Department of Agriculture, Department of Fisheries, DRB, AEGB, etc. have an important role. We believe that they should support primarily work with an essentially direct application to their particular departmental mission, but we hold also that some exceptions should be permissible. It may be that scientists in DRB would be more aware of the significance to them of work in a broad field of science and therefore more excited about some research project even of a pretty fundamental kind than would the corresponding awards panel in NRC; it should be possible for DRB to fund a few projects of this kind. Except for rather few such exceptions, agencies other than NRC and MRC should support only "mission-oriented" projects.

Special Committee

40. In arts we believe that the principal agency should be Canada Council, but in this case we emphasize the need for much more adequate consultation with the universities in formulating objectives and policies. The future role of the Humanities Research Council and the Social Sciences Research Council is not clear to us, but we do not recommend that they have any major funding role.

41. The dangers of a single agency are, of course, that unfortunate policy decisions or poor administration will have a very wide effect and that unusual but imaginative projects or less well established but promising workers may too frequently be refused an adequate grant. For these reasons some diversity is necessary. But it should not be a diversity of federal agencies, for this leads to unfortunate competition, double standards and other ills. The diversity should not arise from provincial agencies for precisely the same reasons -- we have already indicated the role we feel to be appropriate for the provincial governments, viz. research of specific provincial interest and the plugging of gaps in federal provisions. We believe the diversity of sources should be provided by making funds available so that each university can itself provide some support to members of its teaching staff.

42. There is a particular problem in connection with research support for young staff members beginning their scientific careers. Their needs for research funding vary, as do their abilities. They will, of course, apply for grants in the normal way. But the new faculty member is not yet widely known in his disciplinary community and about all a national body can do is treat all such people on a roughly equal footing. On the other hand his own university has assessed the individual's promise much more carefully and should have a very good idea of the extent of backing which is justified. The university should therefore be in a position, through a block research grant, to provide larger than average support to those beginning scholars whom it deems worthy. This argument is as true for the social sciences as it is for the sciences.

43. Somewhat similar arguments apply to the senior man who may be moving perhaps from another country. Here again the university is probably the best judge of the legitimate requirements. Again flexibility is needed to smooth

the transition onto other funding of persons who are phasing out of some external support (e.g., foreign grants).

44. The university may also be one of the better qualified judges of the desirability of backing an unusual project, which may or may not "pay off", and which has not received sufficient support from the central agency. We note with approval the NRC program for rapid funding to allow the development of unusual and highly original ideas; money is needed for "idea development" and the universities should have some money to dispense this way.

45. It is also most important that research opportunities be provided to faculty of those universities or departments that do not undertake doctoral work.

46. For all these reasons, the diversity in research funding should be provided by giving each university a grant for use at its own discretion specifically for research support. It is suggested that this should be from the federal government.

47. If Canada is to make significant contributions to the development of really new knowledge and make breakthroughs in science and technology the atmosphere of freedom must be preserved. The grants policy of the National Research Council has been a major factor in the development of research and in the graduate training of scientists and engineers in Canada. If a grantee must state what he expects to find as a result of his proposed research it makes the discovery of unexpected results more difficult. Dr. Hans Selye, in testimony before the Special Committee of the Senate on Science Policy made this point very forcibly. The Canadian Association of Graduate Schools would urge that the policy of unfettered grants to university researchers be continued and expanded.

48. In this brief we do intend to avoid the temptation to discuss the pros and cons of a Ministry of Science Policy. But we do at this point suggest that if one should be established, it have no operational responsibility for grants. The existing agencies have developed a commendable sophistication and expertise in manipulating the mechanisms of grant and scholarship administration. We cannot of course concede that it is perfect, but it would be foolish to disturb a reasonably smooth operation.

VI. Student Questions

49. There is abroad an assertion that Canadian graduate schools are about to produce too many Ph.D.'s in certain fields. We suggest that there are at least two reasons why this statement should be regarded with a healthy scepticism. One doubt centres on the reliability of the projections, the second on the meaning of "too many".

Several witnesses have already suggested to the Committee that the projection of demand, i.e. employment opportunities, does not take account of the hoped-for expansion of industrial employment nor of the flexibility that holders of the Ph.D. may show in the type of employment they may find suitable. Neither does it account for entrepreneurship amongst these people -- the tendency seen in the United States to found technically-oriented businesses or consultancies.

50. We would like to mention also that the supply figures, i.e. the numbers graduate per year, are not easy to estimate accurately. CAGS has for three years been developing statistics on graduate enrolments and degrees awarded. Projections by the Department of Manpower and Immigration exist, as well as by NRC. But all these projections depend on several factors which are hard to estimate. This is one area where careful research is probably possible, but difficult.

51. We stress the importance of avoiding precipitate action in this area because of possible undesirable distortion of the distribution of scientific competence amongst the different fields of science in Canada. Excess of governmental guidance through the control of funds for graduate education in the light of prospective needs for trained manpower poses two sorts of danger. The first is that narrowly trained specialists should turn out to be trained for the wrong function and be unable to adapt to changing needs because of function-oriented training. This is not unlikely to come about in view of the well known difficulties of forecasting manpower needs over a period as long as the active life of a trained person. The second danger is that governmental concern with manpower training should lead to undue concern with the specific content of what is taught. The vitality and value of Canadian graduate education would be adversely affected by either of these developments. We believe that graduate education, including participation in basic research, is the best contribution that universities can make to

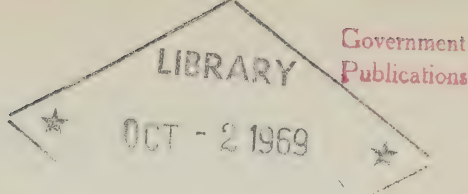
providing fully qualified researchers and scholars. If this is acknowledged, then governments should recognize that the resources provided to the universities for graduate education and research are effectively and efficiently used.

52. Nevertheless, many professors do not fail to recognize that their future graduates may be facing different employment situations than their predecessors. A number of us are giving thought to the need to broaden the training of a Ph.D. student, to make him better prepared for a variety of opportunities on graduation. It has been traditional to insist on a "minor" subject in his course program. Some professors ask if this should not become a much more substantial engagement of the students' attention, and perhaps be rather further removed from his major field than it often is.

53. We should like to comment on the question of Canadians studying abroad and foreign students studying in Canada. We believe very strongly that federally funded graduate scholarships should not normally be tenable outside Canada. If they are, we will never develop graduate work in areas or universities which are not already strong. It is important for the intellectual life of this country that the graduate schools be developed fully. Despite a fairly high rate of return to Canada, it is fair to say that graduate work in social sciences in this country is suffering now from the ease with which students can obtain Canadian government support to study in the United States. We therefore believe that scholarships should be tenable outside Canada only in exceptional cases where there are inadequate facilities in Canada for the particular field of study or where some most exceptional student has the opportunity to work with a very distinguished scholar.

54. We believe that all graduate schools should contain a quota of foreign students. This position is consistent with our view on Canadians studying abroad. It will be realized that we expect that although a good number of Canadians will study abroad only a few will be supported by Canada; the others will be supported by the country in which they are studying. International movement of students at the graduate level is most desirable. On the other hand, the student who is trained in Canada and remains is a very valuable immigrant, and if he comes from the more developed parts of the world, his retention by Canada is just a part of the various international exchanges that occur.

55. In addition, it may well be argued that it is the special duty of the federal government to sponsor students from underdeveloped countries.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA
PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 50

TUESDAY, JUNE 3, 1969

WITNESSES:

Research Council of Alberta: Dr. E. J. Wiggins, Director; Saskatchewan Research Council: Dr. T. E. Warren, Director, Dr. T. P. Pepper, Assistant Director; New Brunswick Research and Productivity Council: Dr. C. Bursill, Executive Director and Deputy Chairman; Nova Scotia Research Council: Dr. J. E. Blanchard, President; Ontario Research Foundation: W. R. Stadelman, President; British Columbia Research Council: Dr. W. N. English, Head, Division of Applied Physics.

APPENDICES:

- 94—Brief submitted by the Research Council of Alberta.
- 95—Brief submitted by the Saskatchewan Research Council.
- 96—Brief submitted by the Ontario Research Foundation.
- 97—Brief submitted by the British Columbia Research Council.

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.”

Extracts from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—

Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 3, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.12 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Bourget, Carter, Grosart, Haig, Kinnear, Robichaud and Yuzyk—9

Present but not of the Committee: The Honourable Senators McDonald and Smith—2

In attendance: Philip J. Pocock, Director of Research (Physical Science); Gilles Paquet, Director of Research (Human Science).

The following witnesses were heard:

RESEARCH COUNCIL OF ALBERTA

Dr. E. J. Wiggins, Director.

SASKATCHEWAN RESEARCH COUNCIL

Dr. T. E. Warren, Director

Dr. T. P. Pepper, Assistant Director

NEW BRUNSWICK RESEARCH AND PRODUCTIVITY COUNCIL

Dr. C. Bursill, Executive Director and Deputy Chairman

NOVA SCOTIA RESEARCH COUNCIL

Dr. J. E. Blanchard, President

BRITISH COLUMBIA RESEARCH COUNCIL

Dr. W. N. English, Head

Division of Applied Physics

ONTARIO RESEARCH FOUNDATION

W. R. Stadelman, President

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

No. 94—Brief submitted by the Research Council of Alberta

No. 95—Brief submitted by the Saskatchewan Research Council

No. 96—Brief submitted by the Ontario Research Foundation

No. 97—Brief submitted by the British Columbia Research Council

At 12:35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie
Clerk of the Committee

CURRICULUM VITAE

Blanchard, Jonathan Ewart, B.Sc., M.A., Ph.D. F.R.S.C., Dr. Blanchard was born in Truro, Nova Scotia in 1921. He received the B.Sc. in 1940 from Dalhousie University and the M.A. in 1947 and the Ph.D. in 1952 from the University of Toronto. In 1940 Dr. Blanchard was employed with the Geological Survey of Canada. From 1940 to 1942 he was Assistant Forecaster with the Meteorological Service, Department of Transport. During the next three years he was a Lieutenant in the Royal Canadian Navy. In the autumn of 1945 he entered graduate studies at the University of Toronto. The following summer, he was Party Chief of geophysical surveys with Conwest Exploration Limited, until 1948. The next year he was appointed Geophysicist of the Newmont Mining Corporation. In 1949 he joined the staff of Dalhousie University and was a lecturer in the Physics Department until 1952. From 1952 until 1957 he was Assistant Professor of the Physics Department of Dalhousie University. From 1957 to 1964 he was Associate Professor and then in 1964 to 1966 appointed Professor of the Physics Department of Dalhousie University. In addition to this, he was Acting Director of the Dalhousie Institute of Oceanography from 1964-1965. During the years from 1949 to 1966 Dr. Blanchard was Director of the Geophysics Division of the Nova Scotia Research Foundation. In 1966 he was offered the position of Vice-President. In 1968, on the retirement of the President, he was appointed President of this organization. He is a Fellow of the Royal Society of Canada. He is a member of the Society of Exploration Geophysicists, American Geophysical Union, European Association of Geophysicists, Canadian Association of Physicists, Seismological Society of America, Canadian Institute of Mining and Metallurgy and the Nova Scotian Institute of Science. He is a member of the Science Council, Solid Earth Sciences Study Group. His publications number 21.

Bursill, C. has been Executive Director and Deputy Chairman of New Brunswick Research and Productivity Council since 1963. He was educated at Cambridge and London Universities where he acquired M.A and Ph.D. respectively. Dr. Bursill began his career as an exploration geologist, was interrupted by service with the Royal Air Force but resumed his career in oil exploration in South America from which he moved to Australia where he was Senior Geologist with the Commonwealth Bureau of Mineral Resources. Dr. Bursill moved to South Africa in 1953 to become, later, assistant chief geologist of Anglo-American Corporation. In 1960 he returned to the United Kingdom and joined the Rank Organisation in charge of its diversification programme, moving to Canada three years later.

English, William N. B. A. (Brit. Col.) 1937 Physics and Maths Ph.D. (Calif.) 1948 Physics Royal Canadian Navy 1940-45 Radar Officer N.R.C., Chalk River 1948-51 Research Scientist (Nuclear Physics) Pacific Naval Laboratory, D.R.B. Victoria, B.C. 1951-62 Section Head; Deputy Superintendent; Acting Superintendent. Bedford Institute of Oceanography, Dartmouth, N.S. 1962-64 Director of the Institute Canadian Armament Research & Development Establishment, Valcartier, Quebec. 1964-68 Director, Electronics Div; Deputy Director-General; Acting Director-General. B.C. Research, Vancouver. 1968- Head, Division of Applied Physics.

Pepper, Thomas Peter, B.A., M.A., Ph.D. Dr. Pepper was born in 1918 in London, England. He received his B.A. in 1939 and M.A. in 1941 from the University of British Columbia and his Ph.D. in Physics from McGill in 1948. He was employed in radar research at the National Research Council (Ottawa) from 1941-1945 and in the Nuclear Physics Division of National Research Council (now AECL) at Chalk River 1947-52. From 1952-1958 he was an employee of Isotope Products Ltd., Oakville, Ontario, serving from 1954-1958 as President of its wholly owned subsidiary Isotope Products (Instrument Division) Inc., Buffalo, N.Y. After the purchase of Isotope Products by Curtiss-Wright he spent a short time with the Curtiss-Wright Corporation at Princeton, New Jersey, before accepting the position of Head of the Physics Division, Saskatchewan Research Council in 1958. In 1968 he became Assistant Director of the Saskatchewan Research Council. Dr. Pepper is a member of the Canadian Association of Physicists, the American Physical Society, the Canadian Operational Research Society and the Operations Research Society of America.

Stadelman, William R.—Born in Shakespeare, Ontario, he subsequently attended the University of Toronto, graduating in chemical engineering in 1941. Later, he attended the Wharton School of Finance and Economics, University of Pennsylvania, obtaining his M.B.A. in 1949. Since 1941 he has held several engineering and technical administrative posts in industry, both in Canada and the United States. In 1950 he joined the Ontario Research Foundation as Secretary-Treasurer, eventually assuming responsibility for all administrative functions of the Foundation. In 1964, Mr. Stadelman was appointed President of the Foundation, the position he currently holds. He is a member of The Ontario Economic Council and of various technical committees and associations, and is the current president of the Sheridan Park Association.

Warren, Thomas Edward, B.A., B.Sc., M.Sc., Sc.D. Dr. Warren was born at North Augusta, Ontario in 1904. He received the degrees of B.A. in 1923 and B.Sc. in chemistry in 1925 from Queen's University, M.Sc. in chemistry from Macdonald College of McGill in 1926 and Sc.D. in chemical engineering from the Massachusetts Institute of Technology in 1930. From 1929 to 1952 he worked in the Division of Fuels of the Mines Branch in Ottawa as research engineer and scientist. In 1945 he served as scientific investigator for the British Intelligence Objectives Sub-Committee in Germany. From 1952 to 1956 he was chief chemist of the Welland Plant of Cyanamid of Canada. He has been Director of the Saskatchewan Research Council since 1956. Dr. Warren is a Fellow of the Chemical Institute of Canada and of the American Association for the Advancement of Science. He is a member of the Canadian Institute of Mining and Metallurgy and the American Institute of Chemical Engineers.

Wiggins, Ernest James, B.Sc., Ph.D., P.Eng. Dr. Wiggins was born in Trenton, Ontario in 1917. He obtained the B.Sc. degree in Chemical Engineering from Queen's University in 1938, and following army service, received the Ph.D. degree in Physical Chemistry from McGill University in 1946. He worked with the Atomic Energy Project at Chalk River from 1946 to 1948, with the Defence Research Board from 1948 to 1952, and with Stanford Research Institute in California from 1952 to 1958. He returned to Canada in 1958 to become Head of the Chemistry Division of the Saskatchewan Research Council. Following a brief period with the Ontario Research Foundation, he was appointed to his present position as Director of the Research Council of Alberta in July 1962. Dr. Wiggins is a member of the National Advisory Committee on Mining and Metallurgical Research, of the Defence Research Board Advisory Committee on

Chemical Research, of the Alberta-Territories Regional Advisory Committee on Forestry Research, and of the Board of Directors of the Alberta Agricultural Research Trust. He is a Fellow of the Chemical Institute of Canada and a member of the Association of Professional Engineers of Alberta, the American Chemical Society, the Canadian Research Management Association, the Arctic Institute of North America and the American Institute of Aeronautics and Astronautics.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 3, 1969.

The Special Committee on Science Policy met this day at 10.12 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have a quorum. There are various Senate committees sitting this morning and, although we do not usually sit in this room, the Committee on Poverty is meeting in our usual room; and the Committee on Foreign Affairs is also meeting this morning. So I presume that this is another example of the Senate at work. It is hard on the members, too.

Senator Bourget: We have also the U.S.-Canada meetings during the next two days, which will take many members away.

The Chairman: This morning we welcome the representatives from the provincial research organizations, and I would ask, first, Dr. Wiggins to come forward and make his opening statement.

Dr. E. J. Wiggins, Director, Research Council of Alberta: Mr. Chairman and honourable senators, I would like to express my sincere appreciation for this opportunity to appear before you on behalf of the Research Council of Alberta, and also for your having allocated time, in your busy schedule, for a special session on the provincial research organizations.

With your permission, I would like to open our series of presentations this morning by saying a few words about the provincial research councils and foundations generally, and then mention some specific points about the Research Council of Alberta. Then the representatives of the other provincial research organizations will follow me and give you their particular points of view. I should explain that I am by no means the spokesman for these groups, but am simply

invited to speak first because our brief happened to be of a more general nature than some of the others.

First, I would like to say that the provincial research organizations are genuinely anxious to play their part in the national scientific and technological effort, and we do feel that they have some special contributions to make in this regard, particularly with the current emphasis on applied science and innovation. I have discussed many of these special characteristics of the provincial research organizations in more detail in our brief, but I would like particularly to mention their strong technological orientation as contrasted, perhaps, with the more basic scientific interest of many of the other Canadian research groups, their flexible, interdisciplinary style of organization, their close contacts with private industry and their familiarity with the important problems and characteristics of each region of Canada.

However, we do also feel that the provincial research organizations have been overlooked to a considerable extent in most studies of national science policy to date, although I am sure that this is quite inadvertent. One probable reason is our habit of categorizing Canadian research into university, industry and government sectors, with the result that the provincial research organizations have tended to be lumped in with the much larger federal Government research organizations and their distinctive characteristics submerged. Another possible reason is the Canadian system of provincial research organizations has no real parallel in the United States or in most other western countries. Consequently, they could quite easily be overlooked when comparisons are being made with the research policies of other countries.

It is worth noting that the provincial research organizations are by no means small scale versions of the federal research organizations, even though they naturally have

some features in common with them. Actually, their closer parallel is with the independent non-profit research institutes in the United States, although here again there are significant differences. For example, the U.S. organizations, although they subsist mainly on contract research, often receive up to 85 per cent of their total support from U.S. Government contracts in the defence, aerospace, nuclear energy, and public health fields. We have nothing directly equivalent to this in Canada and, instead, the provincial research organizations receive a greater or lesser degree of support from the provincial governments for work in such fields as mineral resources, water resources, transportation, and industrial development. In both the United States and Canada the other main source of provincial support for these research organizations is contract research performed for private industry.

It might very well be asked why Canada has a system of provincial research organizations when so many other countries do not. One answer is that the system was introduced at a comparatively early stage in Canada's scientific history, and has evidently worked well enough to persist. Interestingly, several of the provincial groups were started through the efforts of the same Dr. Henry Marshall Tory who had so much to do with the National Research Council in its formative years. A more scientific answer is that the geographical dispersion of the Canadian population has caused the provinces to feel that their scientific and technological needs could not always be adequately met by the central government, due to both distance and regional differences. Also, they have undoubtedly felt that an independent effort would give them an advantage in developing their local economy and in broadening their industrial base. The geographical factor has presumably not operated so strongly in most European countries, while in the United States powerful private interests often arrived on the regional scene at an earlier stage in history.

I have been suggesting that the provincial research organizations should play a distinctive role in the Canadian economy, but I should note also that there are significant differences among the provincial research groups themselves. At one end of the spectrum they may be organizationally independent of the provincial government and obtain the bulk of their operating revenue from contract research. At the other end, they may have a close association with the provincial

government, and obtain most of their support from this source. The Research Council of Alberta falls into the latter category, in that we are virtually the research arm of the Alberta Government. However, even in our case, we do have the status of a Crown agency, and are not directly associated with any department of the government.

The relative proportions of provincial government and industrial contract revenue depend, of course, upon many factors such as provincial government policies and the state of development of the industrial economy of the region. In our own case, the considerable level of government support is due to two factors. One is a policy decision by the Alberta Government to place most of its research in such field as mineral resources, water supply, and highways with the research council rather than conducting this work within government departments, and the other is the fact that Alberta is far from being a fully developed province. Much research is needed in fields that are not yet attractive to private enterprise, and must be supported with public funds. At the same time, the industrial economy of Alberta is developing rapidly, and we expect that our proportion of industrial contract revenue will steadily increase so that very soon we will follow a similar path to that of the Ontario Research Foundation.

I would like to conclude by mentioning some of the topics that concern us in relation to national science policy. The first and most important is that the provincial research organizations be recognized as a vital factor in the Canadian research scene, and that any necessary studies and programs be initiated at the national level to take full advantage of their capabilities.

A second recommendation is that there be improved communication between federal and provincial research agencies. As an example, much of our work on natural resources such as minerals, water, soils, and forest products, closely parallels that conducted by federal research agencies. While there is excellent co-operation in some fields there is rather poor communication on other occasions with the resulting danger of conflict or duplication of effort.

Related to this, we would like to see more decentralization and regional adaptation of federal research programs. Perhaps I am belabouring the issue of regional differences, but I was once again struck by this fact last

weekend when I had the privilege of attending the opening of the new Alberta Resources Railway. The overwhelming, and perhaps even naive, enthusiasm of the people of the Peace River region for the opening of a new railroad would surely seem incongruous to a resident of a more highly developed area where pollution, urban blight, and social unrest are the only respectable topics for concern. I suppose I am simply re-stating the obvious point that Canada is far from being a homogeneous entity, and that any national science policy will have to be extremely flexible.

An effective way of achieving decentralization and adaptation to regional needs would be to take advantage of local talent by contracting out as much as possible of the federal research requirements. Naturally, I have the special capabilities of the provincial research organizations in mind, but I would expect that all such contracts would be open on an equal basis for bids from all qualified research groups, be they university, private industry, or provincial.

On another topic, all of the provincial research organizations consider the encouragement of industrial development, and particularly of secondary industry, to be one of their prime functions. In this respect they attempt to provide as wide a range of services as possible, rather than merely selecting the ones that will bring in the greatest revenue. This often leads to real difficulty in financing the necessary facilities, particularly when the local industrial base is still quite thin, and major contract revenues are not in sight. Some form of federal assistance in establishing facilities for advancing areas of industrial technology would be of great benefit to most of the provincial research organizations.

Finally, I would hope that we would see the complete removal of any arbitrary barriers to co-operation and to funding between federal and provincial agencies. It is difficult for me to be precise as to the nature and extent of this problem, but I believe that most of us have felt its shadow hanging over negotiations at one time or another.

Mr. Chairman, I thank you for the time that has been allocated to me, and I should like now to yield the floor to another speaker.

The Chairman: Thank you very much, Dr. Wiggins. We will hear now from Dr. Pepper of the Saskatchewan Research Council.

Senator Grosart: May I ask a question of Dr. Wiggins before we hear the next presentation, Mr. Chairman?

Dr. Wiggins, are you aware of whether this matter has been brought up at a federal-provincial conference by the provincial premiers? In other words, has there been a formal request from the provinces for specific aid in this area from the federal Government?

Dr. Wiggins: I have to say, sir, that I am not aware of the extent to which this matter has been discussed. It is my impression that it has probably not been the subject of a formal submission, but I may well be mistaken. Possibly the other representatives are able to clarify this point.

Senator Grosart: So it might be in the choice of channels of federal funding made by the provinces that the provinces themselves may have ignored or downgraded this particular requirement?

Dr. Wiggins: This is quite possible, sir, although I would think that they have for some years now at least been aware of the problem.

Senator Grosart: The reason I ask the question is that one naturally wonders after reading the briefs why the federal Government has not, with all its funding agencies, helped to fund these provincial research councils. That is one of the questions to which we hope we will get answers today. If we do not get them here then we shall have to go elsewhere for them.

Senator Bourget: Is it a private organization?

Senator Grosart: No, provincial government.

Dr. Wiggins: As I mentioned, we have varying degrees of affiliation with our provincial governments. At one extreme the B.C. Research Council is essentially, for all practical purposes, a private organization. At the other extreme the Research Council of Alberta is a crown agency of the Government of Alberta.

Senator Bourget: Thank you.

Dr. T. P. Pepper (Assistant Director, Saskatchewan Research Council): Mr. Chairman, honourable senators, representing the scientific staff of the Saskatchewan Research Council we were fortunate to see the submission of the Alberta Research Council before

making our own. We felt that this expressed so admirably our own views that in making our submission all we attempted to do was, first to demonstrate, by making a submission, our conviction of the need to bring the view of provincial research agencies to this committee, and secondly, to emphasize just those items we felt most important.

With regard to the first point, we wish in particular to express our appreciation to this committee for explicitly recognizing the existence of provincial research organizations. To our knowledge this is the most overt recognition we have received to date from the various agencies studying Canadian science.

This leads to the first point we wish to emphasize, namely the need for a special study on the interaction of federal-provincial science activities, with particular attention to support of research and implementation in areas involving those resources falling within provincial jurisdiction. We feel the impact of science, through the various phases of research, development and innovation, to be so great at all levels of government that a study involving one level of government will not do justice to the subject.

The second point we would like to emphasize is that, while there are undoubtedly goals common to Canada as a whole, and therefore shared jointly by all governments, there are tremendous variations in regional conditions, regional needs, and consequently regional empathy, for the resulting challenges. We feel, therefore, that regional or provincial agencies should be expected to bear considerable responsibility for the national effort applied to regional problems. Southern Saskatchewan, for example, is semi-arid. Research into and development of groundwater resources is pursued with first-hand experience in Saskatchewan. Correspondingly, since we have no large industrialized urban area, we are not so close to urban pollution problems.

While speaking of industrialized areas, it is perhaps worth pointing out, as an example of regional variation, that as far as we can ascertain not one of the 97 industrial recipients of the National Research Council industrial research assistance program, as listed on pages 3345-3349 of your proceedings, is Saskatchewan based. I use this example to emphasize that regional variations would, in this instance, point to the value of provincial research agencies being eligible to participate in research on a par with industry, and espe-

cially to act on behalf of those industries unable to undertake their own research programs.

This leads to the final point I would like to emphasize. Since the provincial research agencies are already charged with and experienced in conducting economically useful research, they should be as eligible as industry and as universities for winning contracts and grants for goal-oriented research, development and implementation.

Thank you, Mr. Chairman.

Dr. C. Bursill, Executive Director and Deputy Chairman, New Brunswick Research and Productivity Council: Mr. Chairman, honourable senators, the New Brunswick Research and Productivity Council has not prepared a brief for this committee. I and the council for which I speak are in very close accord with the sentiments and views expressed by our sister organizations. You will know that our council is the newcomer on the Canadian scene, but our policies confine us more or less to mission-oriented research and development. Our council, unlike many of the others, does very little work that bears in a general way on resources or on the problems of provincial government departments. Our primary concern is to offer industry the maximum scientific and engineering assistance at cost to increase its profitability and productivity. To do this, of course, we try always to be a little ahead of industry in R & D.

We have been very fortunate in receiving capital grants from federal funds, and we have believed that our functions and our capabilities were clearly understood at the policy-making level. We do not believe that this understanding extended as widely over the operating levels as we could wish, although I will say that we have had an extraordinary degree of sympathetic technical help from the National Research Council.

Over the few years that we have operated, always very close to industry, we have observed, or at least we think we have observed, some weaknesses of emphasis in applying science to build up secondary industry in Canada, and we would like to recommend the following observations for consideration in a Canada science policy, at least as it affects the fields of interest of research councils.

First, we feel that there should be more clearly defined and more clearly understood recognition of the functions and capabilities

of the provincial research councils, for the reasons that have been so ably surveyed by my colleagues from Alberta and Saskatchewan.

Secondly, we feel that the provincial research councils should be used whenever possible rather than federal organizations set up or support new and parallel capabilities in the provinces.

Thirdly, we think it is very important continually to emphasize that it is necessary to distinguish between the varied research needs of industry and fundamental science and higher education, which are often differently motivated, often best served by quite different kinds of people in different environments and different constraints.

Fourthly, we think it is necessary to encourage wherever possible the decentralization of scientific activities of the federal Government towards universities and the technological activities towards research on the principle of the best possible place, and not on the principle of merely subsidizing new or inferior departments on a diversification basis.

Fifthly, we feel that it would be worth while to attempt to identify, and perhaps develop techniques to counteract, the influences at work that cause institutions which are set up for the advancement of technology—by which I mean applying science—to move towards basic scientific work. The sorts of influences included various techniques of physical control and forming establishment lists and then, of course, there is the lack of industrial uptake, seeking final honour in publications and so on. It is a great privilege that you gentlemen allowed us to speak to you. Thank you, Mr. Chairman.

The Chairman: Thank you, Dr. Bursill. I would like to introduce Dr. Blanchard of the Nova Scotia Research Foundation.

Senator Bourget: We did not get those briefs, Mr. Chairman.

The Chairman: The New Brunswick Council stated that they did not send the brief and I presume this is the same case with the Nova Scotia Research Council.

Dr. J. E. Blanchard, President, Nova Scotia Research Council: Senator Lamontagne and members of your committee, the Nova Scotia Research Foundation is most pleased to be

invited to attend the hearings of the Special Committee on Science Policy of the Senate of Canada. We have followed with great interest the proceedings of this committee and are much impressed by it. Unfortunately, through some misunderstanding, we did not appreciate that we had been invited to submit a brief to this committee.

The Nova Scotia Research Foundation was established by the Research Foundation Act of the Province of Nova Scotia of 1946. The work of the foundation is under the general direction of a board of governors. Senator Blois of your committee has been a member of the board for many years.

The remarks of my colleagues which you have heard and are about to hear, especially Dr. Wiggins, apply to the activities of the Nova Scotia Research Foundation. The New Brunswick Research and Productivity Council and ourselves are unique in that the Atlantic Development Board has provided substantial funds for buildings and equipment without being repetitious.

I would like to make the following remarks. Provincial research councils are unique to Canada. They have also played and can also play a unique role in the economic betterment, welfare and progress of Canada. They satisfy the regional needs of Canada and this is one of the reasons for a difference in emphasis of the activities of these organizations.

For example, the National Research Council assisted program in technical information and industrial organization is a most useful program to Nova Scotia industry.

In general I may say our activities are much more in the field of technology than science and our laboratory facilities are organized to solve local problems.

With the policy of emphasis which appears to be being placed by the Federal Government on directed research and development, the provincial research councils can play a unique role. They have a contribution to make to the general betterment of Canada as well as to a better science policy.

May I thank you, sir, for this opportunity to speak to you.

The Chairman: Thank you very much. Now, Mr. Stadelman from the Ontario Research Foundation.

Mr. W. R. Stadelman, President, Ontario Research Foundation: Mr. Chairman, senators, gentlemen, as mentioned in our brief and in the briefs of the other organizations, these provincial research organizations have many common problems and many common objectives, yet each organization is different in its background, structure and actual capability in its operations.

Each provincial organization reflects its influence and the problems of its province and of its region. Each organization is dedicated to providing answers to the problems of its province and its region. In this respect it is, therefore, understandable that the foundation lays very heavy emphasis on the industrial research aspect of our operations. Naturally it is also concerned that both the provincial and the federal governments adopt science policy which will insure the continued wellbeing of the industry in this country.

As you know, Ontario produces about 50 per cent of the country's manufactured goods. Consequently, it is not surprising that the Ontario Research Foundation is perhaps more deeply involved in industrial research and technological development than any other institution in this country.

The British Columbia Research Council is also deeply involved and committed to industrial R and D. However, Dr. English will present the news of that organization. I shall confine my comments to the Ontario Research Foundation and try to explain to you how it operates. I shall do this by reading from the summary of our brief to this committee. Since it is a summary, it can by necessity only touch on the highlights of our operation.

The foundation was established in 1928 by the joint efforts and equal financial contributions of Canadian industry and the Ontario Government. Since its establishment, the foundation has grown steadily in physical size. Today it employs a staff of about 250 and has an income in excess of \$3.5 million. During the past five years the foundation played a leading role in the initiation and development of the Sheridan Park Research Community. As in 1928, Canadian industry and the Ontario Government participated co-operatively and shared the cost of ORF's new buildings in Sheridan Park.

With respect to our relationship with our clients, the foundation's clients pay the full costs, including overhead and total building and equipment depreciation. All work is

confidential and all patent rights arising from the work are assigned to the client. Thus the cost and benefits to the client are as though the work had been conducted in his private research laboratory.

All Canadian companies and Government establishments can avail themselves of ORF's services on the same financial basis. Foreign companies and foreign government agencies are not given the same privileges as Canadian companies; to merit consideration the work involved must contribute to the foundation's ability to serve Canadian interests.

The nature of the work done at Ontario Research Foundation is strictly applied research. This is the research area, of course, which needs the greatest expansion in Canada today. It is very difficult and often impossible to measure the true economic return of research projects. We have studied one such project at the foundation to see what we could determine about such things. This project had resulted in an industrial plant that gives employment to about 70 men, continuously, and an annual payroll of \$3.5 million. This project at the foundation is yielding, to the Canadian people today, an annual tax return of \$400,000. Of this \$400,000, \$200,000 is collected by the federal Government, \$100,000 by the provincial government and \$100,000 by the municipal governments.

I should like to briefly review the research needs of industry as we see them at the foundation. What I have to say in this regard is taken from the body of our report on the research needs of industry. The range of industrial operations within Canada covers a very broad spectrum and the subsidies of individual firms range from small to very large. This, in turn, means the technological needs of industry in Canada will also cover a broad range embracing virtually all scientific disciplines and varying in scientific depth from the pursuit of advanced scientific studies to the simple provision of known technical information. In general, only about 3 to 5 per cent of Canadian companies are large enough to maintain and support their own research and development organizations. Even so, to these very large companies, the services of a contract research organization are often required by them. The smaller companies are in quite a different position and must depend on outside sources for technological assistance and information.

Below a certain size, companies cannot afford to build and maintain private research laboratories, nor would it be wise to do so. At least 95 per cent of companies in Canada fall within this category. The development of a worthwhile research facility is quite costly, and as research becomes more sophisticated, the more expensive it becomes to pursue, and the further beyond the reach of the individual company to maintain as a private operation.

Furthermore, in today's scientific climate, one or two scientists working alone are in a very incompetitive position. However, there are many of these smaller companies that, although unable to support their own private research team, can afford to sponsor a research program to be carried out on their behalf at a contract research organization. Between 15 and 20 per cent of firms fall in this category. To these companies the availability of a competent contract research body to which they can turn for assistance is of vital importance.

For these larger firms which from 20 to 25 per cent of firms in Canada, the contract research organization such as the Foundation fills an essential need by providing contract research facilities which can be called on as and when required. This group of companies produces at least 85 per cent of Canada's total manufacturing output and employs 80 per cent of the manufacturing labour force. It is primarily on companies in this size range that Canada must rely for the essential expansion necessary for sustained economic growth.

The technical needs of the lower 75 to 80 per cent—by company size—of manufacturing firms do not, as a rule, extend to contract research. Besides being limited by the cost of research, members of this group are sometimes not in a position, technologically nor financially, to make effective use of the results of a research program. The assistance they require can be classified broadly into technical evaluation of products and materials, the investigation of production problems, technical advisory services and technical information. To many small companies help of this type is very important, and although not research, the Foundation has considered it a very necessary and valuable service which it should and does provide to industry. The number of short-term laboratory investigations undertaken by the Foundation in rendering assistance of this type runs well over 1,000.

I would like now to refer briefly to some of the problems common in the operation of a contract research organization. There are several factors which must be accommodated in a multi-disciplinary contract research facility if it is to be both effective and efficient.

Basically, the scientific staff must be strongly oriented towards contract research and internally the organization of the institute must be scientifically oriented, designed specifically to ensure routine accommodation of projects, in other words, it is project organized rather than discipline organized.

In addition to maintaining the scientific competence of the research, the application of oriented research must be undertaken and maintained at all times. And to maintain the continuing effectiveness of the organization, a competence in all newer technology of industrial significance must be acquired.

As I have mentioned, the Foundation today is staffed by about 250 people, 40 per cent of whom are engineers and scientists, 35 per cent are technical support personnel and 25 per cent are administration and maintenance personnel.

The total income from all sources is now in excess of \$3½ million, of which approximately 70 per cent is from work done under contract and 30 per cent is non-contract income. The non-contract income consists of the endowment income. The original endowment of the Foundation in 1928 is still intact and there is a very substantial grant from the Province of Ontario.

Most of the contract income is derived from industrial companies, about 60 per cent, the rest mainly from Ontario government departments, and 11 per cent from federal Government departments.

The amount of the Ontario government grant to the Foundation is based on the contract income from Canadian companies.

This industrial income basis was suggested by ORF to the provincial government, because of its practicality.

First, it provides for the amount of research and other activities which must be undertaken, in proportion to the industrial work done.

Secondly, it provides a very powerful incentive to the Foundation to concern itself with research and development activities that have immediate industrial application.

The Foundation's operations could be made more effective than the present income permits. The Ontario government grant does ensure future and continuing viability of the Foundation. However, if the Foundation is to serve industry with the maximum effectiveness, additional funds are necessary, if we are to supply skills and facilities in all areas of industrial technology. We do not do so at the present time.

It is certainly in the interest of the federal Government that essential technological services be readily available in Canada's most heavily industrialized areas. In terms of the Foundation's total income, and in view of the very large sums expended in research by the federal Government, the present \$25,000 federal grant of ORF is, to say the least, token support.

In view of the Foundation's recognized value to industry and Canadianwide coverage of our operations, it is difficult to understand the federal Government's failure to provide greater direct support to our Foundation.

That, honourable senators, is very briefly, what we do. Ten minutes is scarcely sufficient time to explain it in full. I will be pleased to answer any questions which you may have, and I thank you very much for the opportunity of being before you.

The Chairman: Thank you very much. I must add also that the Ontario Research Foundation has its main laboratory at the Sheridan Park which, as most members at the committee know, is a kind of industrial research campus near Toronto. I understand that we will hear later on during our proceedings from that association.

Mr. Stadelman: That is right. You will.

The Chairman: I had the pleasure of spending a day with you there.

Honourable senators, finally, we will hear from Dr. English, of the British Columbia Research Council.

Dr. W.N. English, Head, Division of Applied Physics, British Columbia Research Council: Mr. Chairman and honourable senators, first, I must bring to you the deep regret of Dr. Trussell that he was not able to be with you today. He is in Austria with an OECD group which is advising the Austrian government on some aspects of their scientific research policy.

Dr. Trussell has had 22 years in industrial research and development. He has a very straightforward and pragmatic philosophy which I am sure you would have enjoyed encountering. On the other hand, I am a rank newcomer to this game. I have joined the British Columbia Research last fall after 20 years in federal Government research laboratories; and the transition from fully funded research to contract research is not an easy one. It is a tough life. We have to be constantly seeking contracts and trying to find funds to buy equipment; and we certainly envy our colleagues in universities the magnificent equipment which the federal Government frequently furnishes to them.

On the other hand, it is a rewarding game because not infrequently we do see a concrete result from some scientific discovery, perhaps made long before we see it actually applied and benefitting the Canadian economy, and we have a very refreshing freedom from complex administration and we have flexibility to do what we feel needs to be done. The only checks and controls are the bi-monthly balance sheets which show whether we are breaking even or losing money.

B.C. Research is an independent non-profit society registered under the Societies Act of British Columbia. It is 25 years old this year.

We have much in common with the other provincial research agencies, and I certainly heartily endorse the remarks made by all my colleagues who have gone before me.

Our budget is just under \$1 million a year. Of this about 60 per cent comes from contract research and about 25 per cent from the British Columbia Government.

The Chairman: On what basis?

Dr. English: The B.C. Government grant is a flat grant. It has increased only very slightly over the years.

B.C. Research would welcome an integrated national plan for research and development. We feel such a plan can and must use effectively the whole spectrum of scientific talent in Canada, from pure academic research through mission oriented basic research and applied research to development and innovation. In such a plan we would hope to see a much increased emphasis on the conditions necessary to achieve innovation, and I know that Dr. Trussell would insist above all on this point, that it is innovation, the actual putting into practice of research and scientific

ideas, that pays the bills. We have very little faith in the spin-off from undirected and unplanned research.

Secondly, we believe that accountability is the key to performance and efficiency. This means that continued support depends on performance. To this end, grants should be replaced by contracts, and a large fraction, but not all, of the basic research should be mission oriented.

We would like to see the administration of research in Canada simplified. We feel that the bulk of research and development funds should be allocated to the mission rather than to research agencies. All technical qualified groups in Canada should be eligible to submit research and development proposals regardless of their affiliations.

As a side note of this, an individual scientist with unusual talents and ideas should have the same chance of federal support, whether he happens to be in a university, in industry or in a provincial research agency.

[Translation]

In concluding, Mr. Chairman, I should like to express a wish that we perhaps regard as somewhat utopian: the wish to see the same kind of mobilization of scientific resources in time of peace as we are accustomed to seeing in time of war, and to see every sector of scientific activity and every region of Canada contributing within the framework of a master plan drawn up by the federal government—with the appropriate consultations, of course—in order to meet the great challenges of our times, such as the communications media, urban problems and the efficient exploitation of our natural resources. Nor should we forget to offer assistance to those countries and peoples less fortunate than we are, here in Canada. Thank you.

[English]

The Chairman: Thank you, Dr. English.

For some of you who do not know this, I think this deserves a word of explanation: Dr. English learned at least part of his French in Quebec City.

Dr. English: All of it.

Senator Phillips (Prince): Mr. Chairman, regarding Dr. English's French, I would point out that there is no translation. However, I would like to compliment him in that he speaks the same type of French as I do, and,

therefore, I did not really need the translation.

The Chairman: Well, we can have a competition and see.

Senator Bourget: Mr. Chairman, there seems to be a general expression of views from different provincial counsels that they face common problems. One question that comes to my mind is whether they have got any national organization that comprises all of the provincial organizations. Have you thought of that? In that way you could present to the federal Government similar points of view, if I may say so.

Dr. Wiggins: Sir, we do not have any such official organization. The closest we have come to it are periodic informal meetings such as the one we had last night.

It does seem like an excellent idea, however.

Senator Bourget: It would seem so. I might say that you presented a very interesting brief.

The Chairman: Would there be difficulties, since you do not have the same status from one province to another? At least you don't have the same status across Canada.

Dr. Wiggins: I don't think the difficulties would be serious, sir. I think that while we have very differing relationships with our provincial Governments, or even lack thereof, nonetheless we each have enough freedom of action that we could join an established organized group.

Dr. English: Perhaps in some ways, Mr. Chairman, B.C. Research is the maverick of this group. I have discussed this at some length with Dr. Trussell and his feeling is very definitely that while, compared to federal research agencies, all the provincial agencies are very similar, they do vary tremendously among themselves.

While we can get together technically, and there is no problem there because we do co-operate technically, nevertheless, from the policy point of view, I don't think it is feasible to represent a common requirement to the federal Government.

The Chairman: You might eventually become competitors.

Dr. English: We are; but we are friendly competitors, sir.

Senator Yuyzk: Mr. Chairman, we have not heard from Manitoba, Quebec, Newfoundland or Prince Edward Island.

The Chairman: Do you know the situation in these provinces? We know that in Quebec there is nothing similar to your operations.

Dr. Bursill: As far as Prince Edward Island is concerned, I can answer. The New Brunswick Research and Productivity Council operates for Prince Edward Island in a fairly informal way. In fact, we have an office in Charlottetown.

Senator Yuzyk: Is there co-operation among the Atlantic provinces? Do these institutions co-operate, say, between New Brunswick to Nova Scotia?

Dr. Blanchard: Oh, I would say that we do co-operate. Mind you we are certainly competitors, but so far as is possible we do co-operate.

Mr. Pepper: There is a Manitoba Research Council Act but it has not really been effectively implemented yet.

Dr. Bursill: There is in fact a Manitoba Research Council but it does not operate a laboratory. It is an information centre. It issues, for example, a monthly bulletin, but nothing more than that. Its staff is very limited.

Dr. Wiggins: On the matter of co-operation among provinces, it might be interesting to mention that there is a somewhat formal vehicle for co-operation among the three Prairies Research Councils which is an outgrowth of the meeting of the Prairie Economic Council whereby we have been encouraged to co-operate in all non-competitive fields. This has been done by a series of meetings among the directors. The fact that the Manitoba Research Council is still in a very embryonic stage has limited co-operation to some extent, but it is quite close between Alberta and Saskatchewan. We will co-operate in every respect except when it comes to bidding for industry.

Senator Bourget: In the brief presented by the Ontario Research Foundation it says:

The nature of the work done at O.R.F. is essentially applied research. This is the

research area which needs to be expanded in Canada today.

Do you mean by this that there is too much basic research done or that there is not enough applied research done?

Dr. Stadelman: This is a very difficult question to answer. I think it is evident that there is not enough applied research, but whether or not there is too much pure research, and by that I mean non-mission oriented research, is another question. I suppose the criteria for determining what a nation should do in this field really depends on what the nation feels it can contribute towards knowledge, and I feel that this would be related to the wealth of the nation and the number of people. In other words I would expect a contribution from Canada in the field of pure research to world knowledge should be far in excess of that of the Congo and much less than that of the United States. If you give me six months, maybe I can be more specific.

Senator Bourget: Later on you say...

In general, the type of work undertaken by O.R.F. is directed specifically to economic or social goals.

Can you tell me who sets the goals? Are they established by the fact that industry comes to you and asks you to do some research in special fields?

Mr. Stadelman: Well, they contact our research organization. We try to do what other people ask us to do and our goals in the social fields are set to some extent by the work we do for the various departments of government. For instance, the Ontario Department of Health asked us to develop a method of continuously analysing the fluorine in the atmosphere—an air-pollution problem. We developed a piece of equipment that is in use today for doing this.

Senator Phillips (Prince): I presume you co-operate with the CBC in that respect.

Mr. Stadelman: I did not know that the CBC co-operated with anybody on air-pollution.

The Chairman: Am I correct in saying that you all operate on a contractual basis?

Mr. Stadelman: That is right.

Dr. Bursill: No. I think it is the aim to achieve the maximum possible proportion of contract work, but from time to time the

situation is otherwise. Basically, as far as New Brunswick is concerned, we are too new to have achieved anything like this as yet. We use a large part of the grant, almost the whole of our government grant for work we think will in due course lead to contract work in local industry. It starts things off, but it is not true to say that we confine ourselves exclusively to contract work. Nevertheless that is our ambition.

The Chairman: Well when you engage in a research project for your respective governments, is this done under a contractual arrangement?

Dr. Bursill: In New Brunswick whenever we undertake any work for the government, we do it under contract for them.

The Chairman: I ask this because I think it would be of interest to the members of the committee who know if there is this element of similarity.

Senator Bourget: It does apply to all you gentlemen?

Dr. Bursill: Well, we generally regard it as competitive work. We do not expect that a provincial government department will offer any contract to us exclusively, but only that kind of work which we can best undertake.

Dr. English: Sixty per cent of our work is contract work, and as I mentioned before, 25 per cent is under the British Columbia government grant. We use the grant money to establish skills which we then can sell, and the contract research goal of 70 per cent of our projects at the present time is estimated to have developed from work started in house, and that did not come to us independently of industry. The worthwhile project that comes from industry is the exception rather than the rule. It is really a question of finding out what industry needs and then developing a skill to meet that need, then putting a proposition to them and selling them on it. This is the difficult part. We feel that innovation is more difficult than original scientific discovery, although it seems that nowadays most credit goes to the latter. This aspect has been badly neglected in Canada.

Senator Yuzyk: Do you actually go to industry?

Dr. English: Yes.

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Senator Yuzyk: And does industry come to you with its problems?

Dr. English: Generally the ones that come have no money. We do what we can for them. But it is normally the small industries who come to us for ideas and have the greatest need of them. We have had the satisfaction of helping a couple of small firms which were on the edge of bankruptcy and putting them into the black again. By and large the small industries come to us for help but in the case of big industries, we have to sell them.

Senator Bourget: Can we sum it up by saying that some contract research comes from small or medium-sized companies who are not financially able to do their own, and a lot also comes from government?

Dr. English: Most comes from the large and medium companies and government agencies. It is worth noting that thirty or forty per cent of our income comes from outside Canada. We earn quite a bit of foreign exchange. About 41 or 42 per cent comes from inside British Columbia and the remainder, about 27 per cent this year, comes from the rest of Canada. So that between 30 and 40 per cent of our income has come from outside Canada in the last decade.

Senator Bourget: Do you mean from the United States, Europe?

Dr. English: Yes, the United States, Europe, and we had one contract from Russia once, but not recently. Then there is South East Asia—we have done work for the United Nations.

Senator Bourget: Do you charge the same fees to outside countries?

Dr. English: We tell our clients we are a non-profit agency, and this is interpreted different ways. Our general rule, I think, is similar to that of any of the councils, that if the work has real scientific content and is helping us to maintain and upgrade our skills, we do it at cost. If it is a chore which really should be done by a commercial, routine testing lab, if there is nothing original in it, we tend to charge a bit more, because you always lose money on these little jobs. It is very difficult not to, unless you charge more than your regular overhead. So, basically, we are non-profit—and non-loss too!

Senator Bourget: I would like to ask these questions of all of these gentlemen. Could you exist, if it were not for the financial help of your government? In the case of Ontario I see it is 82 per cent of 30 per cent—that is 25 per cent—of your total income comes from the provincial government. Tell me this, could you exist today and develop also without the financial help of your own provincial government?

Dr. Stadelman: I do not think so. To maintain a body of skills and sell them to very, very applied people, which is the industrial requirement, I do not think we could do so without the support of the Ontario government. On the other hand, if you look at the institutions in the United States which are also providing contract research, such as Batelle, I have to point out that they get something like \$64 million-worth of federal Government contracts annually. I think that if the foundation had \$64 million-worth of government contracts in an industrial field such as the space program, there is no doubt we would have on our plates the skills that are needed, and if an industrial firm came in, we could take them off the government contract. I do not know what the figure would be, but we would have to be supported by the province.

Dr. English: We could do without the provincial grants, but we could not do without some government money of some kind, government contracts, if they were available without too tremendous an effort having to be put into getting them. However, if you have to make up your government grants by a whole lot of tiny contracts, each of which took six months, you still would not end up very far ahead; but if they were reasonable contracts, I think you could exist without subsidies at all.

Senator Bourget: Addressing the other gentlemen here, I think the financial help coming from your provinces approximate 25 per cent.

Dr. Wiggins: In our case it is a great deal more than this, for a composite of reasons. Firstly, we have some very substantial provincial government contracts. Secondly, we do, in addition to actual contracts, receive, fortunately, rather large block grants for areas where the provincial government wishes to maintain a continuing effort. This is mainly two things: firstly, the investigation of natural resources; and, secondly, our program

of assistance to the small manufacturers, about whom we were speaking some time ago. So, in total, our provincial government support is much more than half of our total income.

The Chairman: How would you divide that between your block grants and contracts?

Dr. Wiggins: Well, our straight, pure industrial contract research at the present time is a shamefully small proportion of our total, about 15 per cent. The provincial government contract work would be about another 40 per cent of our total, and I think the remainder would be the long-term relatively uncommitted grants. When I say "uncommitted," they are for specific things, firstly, broad-scale investigation of the natural resources of the province from which the province hopes to evolve a foundation for development in the future. Secondly, assistance to the manufacturing industry, and in Alberta and the prairie provinces generally this is a very difficult problem, because we have a large number of very small companies, often one-man concerns that have nothing in the way of technical resources, but many of which are quite enterprising that are making a one-man shot as compared to the larger, more sophisticated operation, and they need all kinds of help, technically and managerially, which they cannot pay for, and the provincial government has chosen to invest very heavily in the area of assisting people with their resources.

The Chairman: Are you viewed by your respective provincial governments as a kind of by-product or are you included in their whole research operation, and do they tend to do a great deal of research themselves within departments parallel to your activities?

Dr. Wiggins: This differs dramatically from one province to another. We are probably an extreme example in that, as I believe I mentioned earlier, we are virtually the research arm of the provincial government, and the Alberta government has chosen not to establish research facilities in individual departments and has placed the work with us, mainly on a contract basis. However, there are other provinces, I am sure, where quite the opposite is the case. Because of this fact, I suppose we hold a more prominent position in the provincial government thinking. They are more conscious of us and regard us as being in the overall development program. I think

in some other councils, where there is much less rapport, the attitude may be different.

Dr. Pepper: I would like to follow Dr. Wiggins, if he is through, because we are so parallel to him. There have been a few questions that have been directed to but not answered by the various councils. One was: are we based generally on contract work? As far as Saskatchewan is concerned—and I would like our president, Dr. Warren, to amplify whatever I leave out—we were set up some 20 years ago by act and some 10 years ago with the laboratories to conduct research of economic value to the province. Saskatchewan, as I pointed out in my submission, is under-industrialized and, therefore, I think, in answer to one of the questions, we certainly would not survive on a straight contractual basis of regional or provincial bounds. However, being set up in a rather under-industrialized province, we were encouraged to undertake research to benefit the economy of the province and, therefore, we were and still are very heavily supported by provincial grants, just as is Alberta for about the same reasons, with rather unspecific—from the point of view of industry—goals. For example, there is a study of the ground water resources in the provinces which can serve a number of industries, but the government has chosen to provide this as background or opportunity information for the follow-up of industry, and much of our work is of that nature, preparatory, we hope, to use by industry.

Now, of our annual operating revenue of about \$1.4 million we get about two-thirds from the province to pursue these more general goals preparatory to industrial application.

The Chairman: So that you are also viewed more or less by your provincial Government as their research arm? You have also an industrial function, I guess, but in the main the Saskatchewan Government would go to you rather than do its own research?

Dr. Pepper: We are an agency of the Saskatchewan Government, and I would hazard a guess that two-thirds of "research" done in the province, inclusive of that in the university, would be done in our agency. There are other research projects carried out by the departments, but I think I am fairly safe in saying that the sum of all those would not be more than half of our portion.

To continue with respect to our sources of funds, we get about \$200,000 a year from a shared-cost program with the federal Government under the ARDA arrangement. I do not know whether you would call this contract work, let us call it a shared-cost source of revenue. We get an equivalent amount, approximately \$200,000, from miscellaneous contracts, some of which are with local industry such as the potash companies and the mining companies. Some of our contracts are with the provincial Department of highways, for example, and some of our contracts are with departments of the federal Government. That is roughly a breakdown of our support, but perhaps Dr. Warren can elaborate.

Dr. T. E. Warren, Director, Saskatchewan Research Council: No, I think you have stated it very well.

Senator Bourget: In respect of water research projects do you work in close liaison with a department of the federal Government such as the Department of Agriculture. I understand that water is a problem in Saskatchewan. Do you have any liaison with the Department of Agriculture, or other federal agencies?

Dr. Pepper: I think as a general rule there is every effort made to work with the federal or provincial agencies involved in the water program, but specifically I am not aware of any effort in Saskatchewan by a major department, such as Agriculture, of the federal Government. We are doing some contract work for the Department of Agriculture vaguely involving water through spraying research. We do work in close collaboration with them, and I think on one occasion we worked jointly with the Inland Waters Branch of the federal Department of Energy, Mines and Resources. This was on a joint international hydrological decade program involving also the United States Geological Survey. It was a three-party co-operative program. So far as I know, there are no psychological barriers to our co-operation, but we do arrive at our programs independently of the federal departments.

Senator Bourget: Can you make sure that there is no duplication in the work done by your organization and that done by some other federal organization?

Dr. Pepper: We certainly cannot make sure that there is no duplication, but we try to be aware of all that other people are doing. I think Dr. Wiggins can corroborate me when I say that in the ARDA Ground Water Research Program, which started in the early days of ARDA, the three provinces of Manitoba, Saskatchewan, and Alberta, set up an informal but very seriously attended committee on ground water research. Representatives of the federal Government—and I guess it would be the Inland Waters Branch of the Department of Energy, Mines and Resources—the ARDA representatives, and representatives from the three Prairie provinces met annually at some city in Manitoba, Saskatchewan and Alberta in rotation to review the previous year's tasks and the programs for the coming year. This is correct, is it not, Dr. Wiggins?

Dr. Wiggins: Yes, and I think I have to add this, that this is a genuine problem area and one that I hinted at in my remarks. I think there have been a number of cases of where we have learned about federal programs by reading annual reports.

The Chairman: And perhaps they have done the same thing.

Dr. Wiggins: Probably that is right, but I think the matter of seniority comes into it.

The Chairman: When we hear of provincial governments wanting consultation it is usually only one-way consultation.

Senator Bourget: I should like to hear from Dr. English because I understand that in his brief he mentions the lack of communication and lack of planning. Perhaps he has something interesting to tell us about duplication.

Dr. English: Personally, I do not think any competent scientist will ever willingly duplicate the work of anybody else, but I think there is a genuine problem in respect of communication. People get so wrapped up in their own affairs that they do not talk to other people. I might say that we submit proposals to the federal labs. We have a close link with the federal labs in Vancouver, and with quite a few back east, and I must say that we are always well received. I think the Fisheries Research Board, if I may name one, is outstanding in that they do not try to do everything themselves, but contract out matters that are outside their immediate terms

of reference. Others, in varying degrees, do the same. If they have the money and they will pay us, then we do not worry about whether there is duplication or not. That is their worry.

Senator Bourget: It is only natural in the field of research that there should be some duplication, but due to the fact that we have a limited amount of money to put into research do you not agree that we should avoid duplication as much as possible?

Dr. English: I think, sir, that what we really need is a positive approach. We need guidelines. We need this whole gamut of research. We need fundamental research, but we need it to be related to national needs. I think that if the national needs could be clearly expressed, and the leadership given, and a little bit of funding placed here and there to reinforce them, there will be no trouble in getting people to work towards those objectives, but people cannot work towards national objectives when they do not know what they are.

Senator Bourget: That is quite right. I understand that your research services are available to all Canadian industry, but do you have any figures showing us the percentage of your research work that is entirely devoted to industries that are located in your own province?

Dr. English: Yes, that is 43 per cent.

Senator Bourget: Yes, you have answered that question. You have told us how much of the research work is for industries located in your own province, but can you tell us the amount of research work done for industries located in other provinces or outside Canada?

The Chairman: Perhaps we could start with Saskatchewan?

Senator Bourget: It is very important for us to have this information, because if you want a federal grant then you will have to show the extent to which you are working in the national interest.

Dr. Pepper: The amount of our contract work is, as I have mentioned, a small percentage. Certainly the great bulk of the contract work we have undertaken is Saskatchewan based. However, we have conducted work under contract for one of the departments in

Alberta, the Department of Agriculture, the meteorological branch of the Department of Transport, and I understand the Geological Survey of Canada for the Department of Energy, Mines and Resources. These come to mind at the moment as contract work outside Saskatchewan.

Senator Bourget: Very few industries outside Saskatchewan will come to you for research?

Dr. Pepper: Correct. Or have come to us for research; that is all I can report. We have, as has been mentioned before, been approached by industries with propositions that are not very palatable to us, who want something for nothing. They will come from anywhere.

Dr. Wiggins: We have just been going through a period of building up our facilities for industrial contract research. Until recently we have been limited by our physical facilities and by our manpower, so that we have voluntarily, and perhaps rather arbitrarily, had a policy for the past few years of confining our contract research activities to industries within Alberta, or industries that might hopefully establish operations in Alberta as a result of a successful research project. I would hasten to say that last point leaves a loophole so wide that it allows us to work for just about any country in the entire world. I think we will be dropping these restrictions in the very near future, now that our facilities are within sight of being adequate, so I would say that there is no real limitation. I think for some time now we are not likely to be aggressively seeking work outside the country, unless again there is the hope that it will bring new industry into our part of the world. I think that is a simple statement of the policy.

Dr. Blanchard: I would say in reply to some of your earlier questions about the percentage of our budget that comes from the granting Province of Nova Scotia, in a total budget of the order of \$800,000 a year ago, something over 40 per cent was non-grant. We could not exist without the grant from the Province of Nova Scotia.

I think we would say that all our work is directed towards the betterment of the economy of Nova Scotia. Unfortunately, this does not always result. In fact, at the moment our largest industrial contract will probably result in an industry not in Nova Scotia but outside

Nova Scotia. With due respect to you, sir, I do not agree that the work we are doing should not qualify us for some participation.

Senator Bourget: I did not say that at all. I know very well that even if it is for industry based in your own province it has a national impact. I agree with you. I think this is a very important question, and if in our report we want to recommend something for your organization we have to know all about it. That was the reason for the question.

Dr. Blanchard: I will say that we are very pleased to have had the opportunity to have funds from the Atlantic Development Board, which has been a tremendous help to the Nova Scotia Research Foundation. They provided us with most of the funds for the building we have just moved into.

Senator Bourget: Did you do some research for Dosco?

Dr. Blanchard: We have periodically done work for Dosco. We have also done some work for Cisco, which is the crown corporation that has taken over the company.

Senator Bourget: Again do not think I am against it. Far from it. I was very interested in that.

Dr. Stadelman: It is very difficult to distinguish what is an Ontario company and what is not an Ontario company. Is Canada Packers an Ontario company? Is C.I.L. an Ontario company? The headquarters are in Montreal, with plants in Ontario and right across Canada. Noranda has its head office in Toronto with smelters in various parts of Canada. We have done work for B.A. on the improved oil burner for refinery use. The new refinery being built at Point Tupper in Nova Scotia will be equipped with this new burner developed at the foundation. Is that Ontario or is it Nova Scotia? The tanker, the *Peerless*, which they operate on the high seas and Great Lakes, is also equipped with this. Is that international? We work for C.I.L., having to do with the removal of sulphur dioxide. British Columbia has sulphur dioxide being spewed out, so has New Brunswick; certainly Ontario and Quebec have. We do work for Cassiar Asbestos, whose head office is in Toronto, but I believe their mine is in the northern part of British Columbia. Whom are we benefitting? We are benefitting the mine, we hope, because we will sell more and more asbestos. It is a non-Ontario situation.

I really feel I cannot answer this question. When we do work for the larger firms, and many of the medium firms, we just cannot say that it is for Ontario alone. When it is for some of the very small firms I think we can say it is Ontario; we very rarely do anything for small firms outside Ontario.

Senator Bourget: Do you charge more if it is for a company outside Ontario?

Dr. Stadelman: No, we do not. With even the dollar grant received by us from the Province of Ontario, with the approval of the provincial government there is a matching dollar for industry across Canada, not just Ontario. We have never distinguished in our financial charges between companies from any part of Canada. We do with the Americans or foreign corporations. Maybe Dr. Bursill would like to tell you about the coated briquette project with which all three of us were concerned.

Dr. English: Our ultimate goal and aim is to be a completely independent, non-profit research agency serving our province by our very presence there, the fact that we are available to work on local problems. We have a strong sense of responsibility towards this area, but we do not hesitate to go into other provinces. However, we do not go into provinces in which there is a research council or foundation without discussing it with them, and we do not compete with them. The regions of competence of our specialists are different, so we complement each other. When I write a letter to a firm in Alberta, I send a copy to Ernie Wiggins and if he has any objections he can let me know. He has not had any so far.

Dr. Wiggins: I do not think it would do any good.

Dr. English: Certainly I think you have to say that you cannot.

The Chairman: You mean the combined does not work very well.

Dr. English: You cannot divide it into provincial and national. They are all interdependent.

Dr. Bursill: There is an overwhelming duty which we feel, of course, is to New Brunswick and to a lesser extent to Prince Edward Island, in so far as we are involved with them. The result of this, of course, is

that by far the greater proportion of all our work is for New Brunswick industry. There is very little industry in New Brunswick and we have to try to make some good guesses as to what kind of industry might fit and what we can perhaps do to entice industry or get some of the local companies to provide for it. We sometimes engage ourselves in programs which are rather far in advance of what local companies can do or are likely to be interested in until they see some results. For example, we have quite a large program of fully-powered transmission research which we think will eventually fit into the New Brunswick situation. There has been no one to turn to and nobody to help, because there is no fluid power products being produced in New Brunswick. The result in this particular case is that we go all out for any contract work that we can find elsewhere in Canada, and of course it is elsewhere that this kind of work is being done. What we would expect to see is a gradual enlarging of our facilities and our capability in this field. Eventually, it is the sort of bet that we are paid to make and possibly the seeding of that kind of industry in New Brunswick.

Senator Phillips (Prince): Perhaps Senator Bourget has some more questions.

Senator Bourget: I will come back to them.

Senator Phillips (Prince): I do not wish to leave you with the feeling that you are carrying all of the questions. I would like to ask the New Brunswick group if there is any association with the federal program in northern New Brunswick. Are you being utilized in any way by either the federal or provincial government in planning and developing this program?

Dr. Bursill: Part of it, yes, but only fairly recently. Where this work touches on rationalization of the fishing industry there, we have, in fact, got a contract jointly with the provincial and federal governments and we are investigating this.

Senator Phillips (Prince): Since you stated that you had an office in Charlottetown, were you involved in any way in the so-called economic development plan for Prince Edward Island?

Dr. Bursill: I certainly would not consider that to be a suitable subject for a research organization such as ours.

Senator Phillips (Prince): I have a great deal of respect for you in that regard.

Dr. Blanchard, you mentioned that you had received a grant from ADB for a building. I believe that you also carried out certain projects for the Atlantic Development Board too.

Dr. Blanchard: Yes.

Senator Phillips (Prince): What was the nature of those projects?

Dr. Blanchard: We have produced, as an example, water shed maps for all Atlantic provinces.

Senator Phillips (Prince): Were you in any way involved in a study as to the feasibility of certain industries operating in the Maritimes? I must, in all fairness, tell you, Dr. Blanchard, that I felt that the Atlantic Development Board failed badly in this regard. That is why I am asking.

Dr. Blanchard: I have to be careful here. I am unable to answer that. I am not certain now, historically, as to whether it was the Atlantic Development Board or ARDA that was supplying the funds for certain feasibility studies which we did. That is the reason I cannot answer your question.

Senator Phillips (Prince): Were you involved in a feasibility study, regardless of who was providing the funds?

Dr. Blanchard: Yes. We feel that we could have been involved in a great many more.

Senator Phillips (Prince): What is your relationship, say, to industrial enterprises in Nova Scotia? Do they consult you?

Dr. Blanchard: They occasionally consult us.

Senator Phillips (Prince): I take it that you would like closer liaison with them.

Dr. Blanchard: I believe that we could help them in certain instances, because we have not got capabilities which would answer all their problems.

Senator Phillips (Prince): Mr. Chairman, in listening to the remarks from the interior group I rather felt I was at a dominion-provincial conference where Ontario likes to remind us that they have 50 per cent of all manufacturing, and so on.

The Chairman: They very seldom mention the Canadian tariff.

Senator Phillips (Prince): That is what I was coming to. There is no use in giving my standard reply to that. *Hansard* would not print it.

I was going to ask you sir, whether you get many requests from the firms who take the tariff regulations into consideration in their programs? I think both the chairman and I are in agreement that they favour Ontario.

Mr. Stadelman: In any applied research program, particularly in industrial fields, you must develop the economic analysis along with the technical analysis. At that point in which the economic feasibility is bad and the technical feasibility is good I suppose you drop the project. At that point much of the technical feasibility looks bad and the economic feasibility looks good and you keep looking at it.

Senator Phillips (Prince): Thank you. I have got my point on the record.

Senator Yuzyk: I have two questions. One is regarding the Science Council of Canada. Have any of these provincial bodies any relation to the Science Council of Canada? Have you been consulted or asked to carry out any research work for them?

Dr. Blanchard: A specific answer to your question would be no.

The Chairman: There is no relationship between these research agencies and the Science Council. The Science Council, as you know, has done very little research.

Senator Yuzyk: Has there been any kind of co-operation with the Science Council of Canada?

Dr. Blanchard: The Nova Scotia Research Foundation—I am a member of the study group on solid earth sciences—is presently preparing a report on the solid earth sciences. Dr. Smith, my predecessor, is President of the Foundation, and he is also a member of Mr. Tyas Committee.

Mr. Wiggins: I think the answer is that individuals have been asked to serve on committees of the Science Council, and organizations have not.

The Chairman: They do not deal with organizations.

Mr. Wiggins: For example, I served on the Water Resources Committee in preparing the Science Council report on that subject, and another member is a member of the Solid Earth Sciences Committee that you have been mentioning. In that case there has been some communication through individuals.

Senator Yuzyk: Can we hear from Ontario?

Mr. Stadelman: I can say my reaction is about the same as that from Dr. Wiggins of Alberta. There are people on our staff who have participated in the federal committees of the Council. I am sorry to state that no one of the gentlemen from the Research Councils in the province has ever been asked to serve and I think this is an oversight, or it is unfortunate that this has not been done. The Council did once meet with the Ontario Research Foundation.

The Chairman: I suppose this would raise a problem which might be beyond your own area of interest. I do not know of any federal institutions advising the federal Government on federal policies, where they are provincial civil servants or provincial employees.

Dr. English: Provincial university professors, sir. What is the distinction?

Mr. Wiggins: Not wishing to beat the subject to the ground, may I say this was one instance in which we did attempt to make some progress, in that we recommended to the Science Council that there should be some representation from the provincial councils—not as representatives of the provincial governments, which essentially we are not, to begin with, but as representatives of a special group with a special orientation on science policy.

Unfortunately, this recommendation was not accepted. Either because we made this recommendation, or because it was not accepted, we are still somewhat sensitive about the fact that the Science Council Report No. 4 manages to discuss Canadian science policy without once mentioning the provincial research organization.

The Chairman: They have recognized that it was only a report towards a national science policy and they have ignored a lot of other things as well.

Senator Yuzyk: My other question is about long-term projects. How basic in the operations of the provincial bodies are long-term projects, or say long-term contracts, and how long are some of these projects, in years?

Mr. Wiggins: I should perhaps answer that since we have some of the big ones. The problems which we have in national resources are long-term in years—not long-term in the sense of long-term in the work we do is more down to earth but, due to the magnitude of the problem, that will go on as long as the provincial government sees fit to fund it.

We have been working on the national resources of Alberta since the Council was established in 1921 and there is no end in sight to the job. So it is indefinitely long program, which is made up of a series of projects, all of which are very specific in their purpose and very aptly applied in their nature.

Similarly, with other long range programs of assistance to small industry, this consists of an indefinite progression of two-day to two-week projects.

Dr. Pepper: While we have the same characteristic to some of our projects, I think perhaps Mr. Wiggins would agree that there are several projects that involve resource development which, by their very nature, require a long time—those that involve the climatological effect on agriculture, or the rainfall effect on the ground water. The measurement of the movement of ground water is just by its very nature measured in decades rather than in years. Even though it may not take the full time of a researcher, he has to set up his instrumentation this year, for the useful measurements that he is going to be interpreting perhaps ten years from now. So there is that additional type of long-term project, and I think, Mr. Wiggins, you also would have some of those.

Mr. Wiggins: Quite.

Senator Yuzyk: What proportion of the budget would be for long-term projects? That is what I am interested in, on the operations. Is it half of your budget, or half of the funds?

The Chairman: It is apt to fluctuate.

Senator Yuzyk: I know, but in general?

Mr. Wiggins: Ours, sir, would be in the order of 35 per cent.

Senator Yuzyk: And Saskatchewan?

Dr. Pepper: I would not know which side of the cut our figure would fall.

Senator Yuzyk: But, more or less?

Dr. Pepper: It is a significant proportion.

Dr. Blanchard: I am not quite clear as to what you mean by long-term projects. As an example, a project which has been going on with the Nova Scotia Research Foundation almost since its inception in 1947 is an investigation of the seaweed resources around the coast of Nova Scotia. We are gathering information about seaweed and this has been going on during the whole history of the Nova Scotia Research Foundation.

Senator Yuzyk: And it will continue for many many years?

Dr. Blanchard: Yes, I think it will.

Senator Yuzyk: This is what I would like to find out. What proportion of your work is devoted to long-term projects, in other words, the continuity of your work?

Dr. Blanchard: We have another one, initially, on research based projects. We have another in geophysical data for the Province of Nova Scotia, and this one has been going on for nearly 20 years. Something of the order of 10 to 15 per cent of our budget may be involved in this sort of work.

Mr. Stadelman: Some of our industrial projects have been going on for a long time. One of them has been going on for over 18 years. Now the objective of that project has changed, as the company moved from one thing to another. At first it was a company devoted to reducing the cost of raw material. When that was accomplished, it turned into something else, and later it turned into the development of new products. This work has been going on for 20 years and has been renewed each year. But I do not think this is what you are asking about.

We have another survey of air pollution in the Sarnia area, sponsored by industrial firms. That has been going on for 15 years.

We have a contract with the Department of Lands and Forests of the Province of Ontario, which we foresee going on for another decade. This is a development of the quickest growing strains and species of trees for pulp

and paper purposes in northern Ontario. In other words, in the case of southern pine, it grows very rapidly to maturity in 15 years, as opposed to maturity in 60 to 80 years in northern Ontario.

We are trying to pick out strains of trees that will mature earlier and grow more quickly, to get the highest yield of fibre per acre per year. That is a long-term project.

The Chairman: How does it fit in with the kind of research that the Canadian Pulp and Paper Research Institute is doing? They are doing something of that kind.

Mr. Stadelman: Yes, this all fits together in a sort of big jig-saw puzzle.

The Chairman: And our own laboratories.

Mr. Stadelman: Yes. It all fits in together. Each group knows what the other is doing. We are doing the pulp and lumber characteristics of the tree, and we know what the others are doing.

We would not develop a skill in the industrial area unless we could foresee being funded from three to five years. You could not develop a skill otherwise. Forty per cent of our work is long-term, in that sense.

Dr. English: This is a critical problem so far as we are concerned, and it competes with the other critical problem of where to get the funds to set up equipment in an area that takes a large capital investment.

We have two programs that have been going for at least 15 years. One is on the olfactory response mechanism of insects and how to fool them or mislead them or block them. It has covered a wide variety of insects. This program would not have been possible without American support and also some support from the National Research Council, although that support has terminated in recent years.

The other program is in bacteriology and marine biology. The bacteriology aspect has been largely supported by mining companies, a consortium of which we got together by the expedient of going from one to the other to get their support. We have to use our provincial grants to set ourselves up and to get research contracts. Therefore, this tends to fluctuate. It cannot be used for the long-term program.

We would like to see more opportunity to bid on mission oriented basic studies for national needs. It would help us a great deal, if we were eligible to bid on these, and if they were let out to contract rather than all being done in federal laboratories.

The Chairman: I am sure there are very few contracts being given in these fields.

Dr. English: Well, the Fisheries Research Board gives some.

The Chairman: You say, if you were eligible, but you are eligible, are you not?

Dr. English: What I mean is the mission oriented basic research is not put out to contract.

The Chairman: To the extent that these contractual arrangements are used, you are eligible.

Dr. English: A great deal of it is put out to universities.

The Chairman: On the basis of grants?

Dr. English: The National Research Council just does not have funds to give us contracts. This is why they terminated their support of the insect studies, although they said it was excellent work and, if we could persuade our man to move into a university, they could support him. That does not seem right.

Senator Yuyzk: What was the proportion?

Dr. English: It was less than 25 per cent.

Senator Yuyzk: What was it for New Brunswick?

Dr. Bursill: In New Brunswick we have only been going for four years so we have not undertaken what you would call really long-term projects. As we are set up, and even temperamentally, considering the sort of people we have now on our staff, we would tend to avoid long-term projects. They are not the kind of thing that interests us. We plan rather carefully before we start a project in order to determine, as it seems to us, what the criteria of success are. We have learned that the criteria of success have a way of altering quite rapidly over quite short periods of time.

I would say that we have more or less an unwritten policy in this matter. We try to

restrict all our projects to those which in our terms will pay off under four years.

If you like to divide our work into these which will fall clearly into that kind of category in which we are going to be concerned as to when to cut them off within that four-year period, I would say 15 per cent.

Senator Robichaud: Dr. Bursill, you spoke of your permanent staff. Will you tell us what, on the average, your total budget is for that staff and how many permanent staff members you have?

Dr. Bursill: Our total budget is in the order of \$800,000 a year at the moment. Our total staff is roughly 65, of whom approximately 27, I would say, are professionals in any useful sense of the word.

Senator Robichaud: By professionals you mean scientists?

Dr. Bursill: Scientists and engineers.

Senator Robichaud: You mentioned earlier, also, that you were doing some research on a large project on power transmission. What are your main other fields of operation? Are they in mining and forestry?

Dr. Bursill: No. We chose initially to set up these areas of special competence, firstly in food science and technology, because we thought at that time that this was a major point in New Brunswick and it would be very desirable. That department has expanded gradually—at least, I should say that we have not expanded our food capabilities but that the department itself has expanded because it has been called upon to do so in the field of chemistry.

Secondly, we have taken a very considerable interest in the field of minerology—a rather restricted application of science to some specific problems in the mining filed in New Brunswick.

Thirdly, we are in the field of mechanical engineering, in which, for example, the hydraulic engineering fits—fluid power engineering.

Fourthly, we have gone to electronic engineering which acts principally as a service but not necessarily so. It undertakes a number of special duties such as product testing, for example.

Finally, we have what we call management engineering, in which we are rather heavily

weighted, relative to other research councils, because we consider that to increase productivity by the most direct methods possible in New Brunswick is a particularly desirable activity for us.

Senator Robichaud: Did I understand you to say earlier that the council is undertaking a study of the feasibility of the fishing industry?

Dr. Bursill: We have some rather specific terms of reference relating to one part of the fishing industry in New Brunswick.

Senator Robichaud: The Bay of Fundy?

Dr. Bursill: No, this is the northeast area.

Senator Robichaud: At whose request was this study undertaken?

Dr. Bursill: The local Department of Fisheries in New Brunswick, together with a federal agency. I can't remember which federal agency it is, at the moment, although I am told it is under FRED.

Senator Robichaud: Has it to do with in-shore or off-shore fishing?

Dr. Bursill: Both, but we think the main interest is going to be in-shore fishing.

Senator Phillips (Prince): Dr. Bursill, could you elaborate a little more on the nature of the project?

Dr. Bursill: The part we are playing in this, is, fundamentally, an operations research or an operations analysis investigation.

Senator Phillips (Prince): On all types of fish or just specific types of fish?

Dr. Bursill: I think it is all types of fish in the area, yes.

Senator Robichaud: Is these not a danger of duplication? Is such information not already available from either the federal Department of Fisheries or the provincial department?

Dr. Bursill: Actually, our project has not to do with fishing itself. We are concerned with the movement of fish and the physical facilities and with the efficiency of the operation in total. This is not a biological investigation at all; we have no biological capabilities.

Senator Bourget: I understand these gentlemen representing the different associations

will gladly accept any kind of help from the federal government. However, I would like to find out what their views are in general as to the best way in which the federal government could help their organizations. Does any one of you gentlemen have a practical recommendation that you can give us?

Mr. Pepper: Well, I can start off very generally with a suggestion which may not be of too much specific value. Nevertheless I shall mention it as a suggestion. I believe we have already drawn attention to the fact that we would like to see a thorough-going study of the federal-provincial science situation. As a result of that study I would hope that there would be some very specific suggestions made and some avenues opened up. Now in second guessing and in presenting one's own prejudices ahead of that, I would like to recommend such a study personally, and I would like to see that research agencies such as those represented here today and others that represent regional or provincial organizations should not be given any preferred treatment, but also should not also be discriminated against. In other words I suggest that we should be treated on a par with universities if the work to be undertaken is of such a nature that it might be undertaken in a university or in an agency such as those represented here today, and we should be treated on a par with industry for work which in turn might be undertaken by industry or by agencies such as ours. I think basically if the restrictive conditions were removed and we could feel that we were in the marketplace, as it were, with everybody else, then we would be very much better off than we are now.

The Chairman: What are the restrictions?

Mr. Pepper: I hope that some of the others may be able to help me out here. Let me put it this way; there are a number of sources of funds available to universities, for example from the National Research Council or perhaps from the Department of Energy, Mines and Resources or the Department of Agriculture, that are not, as I understand it, available for research.

The Chairman: I suppose you are not eligible to receive grants from federal agencies, but so far as contracts are concerned you are not in any unfavourable position.

Dr. Wiggins: Well, Mr. Chairman, there are contracts and contracts.

The Chairman: I am trying to find the area where there might be discrimination because of the system. It is not because you are put in a different category?

Dr. Bursill: It was mentioned in one of the briefs, and I forget which one, that there were some restrictive terms.

Dr. English: There are programs to help industry and to help universities, and we are largely excluded from those programs.

Dr. Wiggins: I think I can give you an example of this. There is in our province at the present time a very serious suggestion by a group of people that our council should be phased out and instead a university-based research council be started. The motivation for this, as I understand it, is that many sources of federal funds would then immediately become available. I certainly do not think that this is the purpose of the various federal support programs to replace one existing institution with another. This is symptomatic of the things we are complaining about where there is no direct discrimination, but where the structure of the programs tends to favour universities and to a lesser extent industry and to make only limited provision for organizations such as ours.

The Chairman: If, for instance, you were invited to become a member of the Science Council, or any of these federal research agencies, do you feel you would have to consult with your provincial government before accepting the appointment?

Dr. Wiggins: I would not personally feel this, no.

The Chairman: I am trying to find out what the status is because it may well be that our federal agencies view you as strictly provincial agencies.

Dr. Wiggins: This is an important point but, as I said, I feel I would not have to consult our government because I am assuming I would be invited to join such a science council as representative of this group of organizations rather than as a representative of the Alberta government. It is in the latter situation that federal-provincial problems would come into play.

Dr. Blanchard: Mr. Chairman, I do not think that we or the other members here to-

day are looking for specific assistance from the Research Council. We are looking for programs to assist Canada, and while we do not wish to labour the duplication which may exist in Canadian science, because we do not regard it as the worst example of duplication, nevertheless the situation is such that if I were a member of a university, as I was for a number of years, I believe there are half a dozen federal agencies from which I could get support today from the federal government. It seems to me there should be one agency for making grants to support research and another agency which would be involved in contracts for direct research. I think the aims of those going in for direct research would be much better accomplished in this way, and if this research contract field were open to industry, research councils and universities, I think we would then have a more viable economy and more scientific aid to the economy.

The Chairman: Let me come back to my previous question. Would you have to consult your government before accepting a kind of federal appointment?

Mr. Stadelman: No. As far as I am concerned we are an independent agency of the government. It is not part of government; it is an independent organization.

Dr. Bursill: This would be true for New Brunswick. We would not have to consult the government.

The Chairman: Then you do not consider yourselves as being provincial agencies for all practical purposes.

Dr. Bursill: For operating purposes, no. You used the term a little earlier and in a general sense "provincial employees". We do not consider ourselves in this way at all. We do not consider ourselves to be provincial employees.

The Chairman: That is quite important, I think, in trying to find out your relationship with federal agencies, because I am sure that if the Deputy Minister of Economic Affairs were to be invited to join the Science Council he would have to consult and seek the approval of his minister. So that in this respect you are quite different.

Senator Bourget: You are getting a little away from my question, though it is connected. I was waiting for answers from these gentlemen.

The Chairman: You might restate it.

Senator Bourget: What would be, in their view, the best way for the federal Government or its agencies to help their organizations?

Dr. Stadelman: I think the giving out of more contracts to all types of institutions and asking for competitive bids would be one. In our particular case, I think an undertaking to help us develop a skill in an area for over a term of three years, with the understanding that after that time it would be dropped, because at that point industry should be able to carry on by itself, without support.

Previously, for instance, with regard to the National Research Council Industrial Research Assistance Program, it was not possible, until a few months ago, for a company to get a grant from the Council under that program and have the work done by a provincial organization.

The Chairman: But do I understand it is now possible?

Dr. Stadelman: I understand it is. Well, I will put it this way, I have had communication from the National Research Council that they intend to revise their act.

Dr. English: That is in 1971. It is imminent, sir.

Dr. Blanchard: Because of the lack of funds to do everything, they would have to have a change in their act.

Dr. English: They have not changed their act, as far as I know.

The Chairman: They cannot do that because of their act?

Dr. English: That is what I am told.

Dr. Stadelman: My understanding is that an Order in Council could be set up.

Dr. English: Yes, they have to have an Order in Council to do it.

The Chairman: It is quicker than changing the act.

Dr. Stadelman: Inadvertently—or, I hope it is inadvertently—it made it impossible for a company to apply for such a grant and have the work done, in turn, at, for example, the

B.C. Research Council, with the company providing the overhead and the NRC providing the salaries of the people.

Dr. English: We could work with a company on a paid program.

Dr. Stadelman: That is true. Under the Provincial Organizations Act they are considered to be research expenditures.

The Chairman: What about contracts given by the Defence Research Board?

Dr. English: We can work with them. They are the most flexible of all.

The Chairman: This is with regard to NRC then?

Dr. English: Yes.

Dr. Wiggins: Though the situation has not been clarified with respect to some of the other granting agencies. Energy, Mines and Resources have the impression it is still under negotiation, whether they will be able to award contracts for research in water resources or in the other mineral resources fields.

The Chairman: But if there were grants given by federal agencies for research to provincial agencies, would not the provincial governments see that as a kind of interference in their own field?

Dr. English: Universities!

Dr. Stadelman: How about universities?

The Chairman: As far as I can see, the universities have a very special status in our country, though several are provincial institutions or public institutions.

Dr. Wiggins: There have been grants on a small scale in the past which, incidentally, are drying up now, and there has never been any objection. For example, Dr. Stadelman, I think, has received \$25,000 a year from the National Research Council; and we receive \$10,000 for the same type of work. These are being terminated this year, but these have been in effect for many years, and no question has ever been raised by any provincial authority.

The Chairman: Were they general purpose grants?

Dr. Wiggins: Block grants for fundamental research, and we have had Dominion Coal Board grants at our establishment in the past. I think the constitutional problem has not arisen, particularly when it is a matter of money being received.

The Chairman: We never know.

[Translation]

Senator Bourget: Dr. English, what would be your recommendations?

Dr. English: They are very simple. We would like to see large amounts of money going into research rather than being spent on laboratories, and we would like to be able, and allowed, to make our representations.

[English]

Senator Bourget: You would like to be on the list?

Dr. English: We would like there to be a list, and we would like to be on that list.

The Chairman: So, in general, you are not really asking so much for grants, but you are asking for a more general application of the contractual arrangements throughout the federal agencies?

Dr. English: Yes.

The Chairman: By definition, you would be treated like all the others?

Dr. English: Yes.

Senator Bourget: That is the general point of view of the gentlemen here?

Dr. Wiggins: I think perhaps the only exception is the proposal that one or two of us have put forward in various forms, that there might be some form of assistance in establishing competence in new and developing areas of technology that comes closer to being a conditional grant, whatever you call it. I think particularly those councils which rely heavily on contract research find it difficult to move into new areas, to make heavy investment in capital facilities and the training of people to take their place in the advancing technology.

Dr. Blanchard: This still could be under contract.

Dr. Wiggins: Yes, but I think that is a point of semantics.

Senator Bourget: What about personnel? Are you able to compete with governments, universities and private industry, or have you experienced difficulty in obtaining the first-class research people you need in your labs and your organization? Do you pay the same salary?

Dr. Bursill: Yes, we pay the going price, but we have the very greatest difficulty in bringing really first-class research people to New Brunswick. It is extremely difficult.

Senator Bourget: Do you think in the future we might lack some good personnel in research, from your experience?

Dr. Bursill: I think we would like to get the people quicker. We eventually get the people we want, but it takes a very long time.

Dr. Wiggins: I have one specific comment. I think we have found there is no numerical shortage of applicants, particularly within the last couple of years. However, we still find it very difficult to obtain people who have an orientation towards the particular type of research we do and who are willing to operate in this environment. Canada has trained all too many researchers who are ideally adapted to staying on in the university.

Dr. Bursill: Yes, I have the figure here. We sorted through 1,450 applications to acquire the last 25 people.

Senator Bourget: We have been told by many people who have appeared before this committee that they expect there will be too many scientists. Is this your view? Do you think there will be too many of them?

Dr. English: We have no difficulty in getting people, but I view the supposed excess of scientists and engineers with much less trepidation than I view the tremendous excess we are going to have of political scientists and social scientists, and all those on the other side of the spectrum.

The Chairman: There is a great scarcity of economists.

Dr. English: I think that some of these people might even have to teach in schools, which might not be a bad thing at all.

Dr. Bursill: But, scientific qualifications do not necessarily make a scientist.

Senator Bourget: Are most of your researchers of Canadian origin, or do you have to get some from the United States and Europe?

Dr. Bursill: New Brunswick is, by and large, a place where the population is steady. If anything, people tend to leave rather than migrate to New Brunswick, and the result is that we have to look outside of Canada. I daresay something like 50 per cent of our whole staff are Canadians.

Senator Bourget: As of now?

Dr. Bursill: Yes, as of now. There is a very interesting development taking place which, a few years ago, was looked upon as being the turning point in our affairs. We looked forward to having really first-class local graduates come back to New Brunswick. I am delighted to report that this year this is beginning to happen, and perhaps this is really the turning point.

Dr. Wiggins: If you go back ten years, sir, I think you will find that we had to recruit the bulk of our people from outside Canada, and as a result our staff is now a small united nations. This has its advantages. I do not think there is a European language in which we cannot converse with visitors. During the last few years, as Dr. Bursill has said, there has been quite a change, and we have recruited a high proportion of Canadians, and particularly Albertans. We have found that Albertans are particularly vulnerable when they come home to Alberta for the Christmas holidays after taking a job in Ontario.

Senator Bourget: But as of now what is the percentage?

Dr. Wiggins: It would be barely half.

Senator Bourget: What about Ontario?

Dr. Stadelman: We experienced difficulty in hiring technical personnel a decade ago, and the foundation hired many people from outside Canada, particularly from Great Britain. During the last few years the situation has changed, and in most areas we do not have any trouble. Of course, if you are looking for a highly specialized individual with a certain amount of industrial background, or something like that, then finding him may take a considerable length of time.

Senator Carter: How many Ph.D.'s are employed by the Councils represented here, and how many of them are Canadians?

Dr. Pepper: In answer to the question as to the percentage, I will say that about 85 per cent of our total permanent staff are Canadians. I think we have 14 Ph. D's on our staff now, and there is only one non-Canadian Ph. D. so far as I know.

The Chairman: Are you looking for Ph.D's rather than M.A.'s?

Dr. Pepper: No, I am just answering the question. For some positions I think we would like to have the qualifications of a Ph.D., but for many other positions we would prefer to have engineering or some different qualifications.

The Chairman: Does this reflect the situation in the respective provinces?

Dr. English: A quarter of our staff are Ph.D.'s, and nearly all of them are Canadians who got their Ph.D's outside Canada. This sort of reflects their age, I think. We have imported quite a few staff from Europe in order to get people with industrial experience, but there is no problem in hiring local people, and this is now the trend. However, I must say that they are not motivated in some engineering faculties in the universities towards industrial research. The really good ones are motivated towards becoming university professors.

Dr. Blanchard: Less than ten per cent of our staff is non-Canadian. I do not know whether that reflects on the advantages of Nova Scotia.

Dr. Bursill: Of course, I would like to point out that we are coming up to our fifth year of operation, and our people are fast becoming Canadians.

The Chairman: On behalf of the members of the committee I should like to thank you all very much for spending these few hours with us, and I hope that you will find that our report, when it is prepared, is of some use to you.

The Committee adjourned.

APPENDIX 94

BRIEF

**To the Special Committee on Science Policy
of the Senate of Canada**

by

**The Research Council of Alberta
87th Avenue and 114th Street
Edmonton, Alberta**

B R I E F

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

BY

THE RESEARCH COUNCIL OF ALBERTA

87th AVENUE & 114th STREET

EDMONTON, ALBERTA

Special Committee

BRIEF
TO THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
BY
THE RESEARCH COUNCIL OF ALBERTA

SUMMARY

The provincial research councils and foundations have special characteristics that distinguish them from most other types of research organizations. While relatively small, their contributions are particularly significant at a time when great emphasis is being placed on the applications of science and technology and on the need to perform more of the research and development work near the point of commercial application. The work of the provincial research organizations is predominantly oriented toward problems of direct economic and social significance, and is performed in close association with the industry or government agency that can utilize the results.

Their flexible, multi-disciplinary style of organization, their strong technological orientation, and their familiarity with the important problems in each region of Canada should enable the provincial research organizations to play an important part in the national effort. Various measures are suggested to ensure that full advantage is taken of the present and potential capabilities of these organizations.

The suggested measures include the recognition of the provincial research organizations as an integral part of Canada's scientific and technological resources; increased decentralization of federal scientific activities to improve regional contacts and to provide greater opportunities for local initiative; contracting out federal programs whenever possible to other research organizations in each region of Canada; removal of any legislative or administrative barriers to co-operation between federal and provincial research organizations; and maximum use of the capabilities of existing research organizations before new groups are established with federal support.

BRIEF
TO THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
BY
THE RESEARCH COUNCIL OF ALBERTA

1. We wish to draw the attention of the Committee to the special contributions that can be made toward Canada's development by the provincial research councils and foundations, since these organizations have received little attention in most studies of national science policy to date. In our brief, we wish to outline the particular characteristics of the provincial research organizations and their relationships to other research and development groups. Finally, we wish to suggest ways in which the federal government can ensure that maximum advantage is taken of the special capabilities of the provincial research organizations in attaining national goals. While many of these observations will refer to provincial research councils and foundations generally, it will be understood that we are competent to speak only for the Research Council of Alberta, and that our suggestions may not be applicable to all.
2. The total volume of research and development work performed by the provincial research councils and foundations may appear small by comparison with that of the federal government, of private industry, or of the universities. However, there are several important fields such as water resources research and transportation research where the programs of the provincial research groups are among the largest in Canada. Also, it is felt that the provincial groups fill a unique position in the Canadian research and development effort, and that the value of their work to the national economy is much larger than its dollar volume alone might suggest.

3. Almost all of the work of the provincial organizations is mission-oriented and is related to problems of real economic and social significance; in fact, many of the objectives laid out in Science Council Report No. 4 have long been accepted by the provincial research groups. The provincial groups are in close contact with private industry and other segments of the public, and are thoroughly familiar with the problems and opportunities of their regions; correspondingly, most of their work is performed in direct association with private industry or local government and has a high probability of being utilized. The provincial groups generally take a very active interest in promoting the utilization of their research results since they recognize that these results are of no benefit to the economy until they find practical application.
4. The terms of reference and mode of operation of the provincial research organizations are quite distinct from those of most federal government, university, or industrial research groups, and their activities frequently complement the work of these other groups. For example, while there are parallels with certain federal organizations such as the National Research Council and the Department of Energy, Mines and Resources, there are also significant differences which make it possible for the provincial organizations to perform certain types of work with particular effectiveness. As mentioned earlier, the provincial research organizations enjoy the advantages of close contacts with private industry and of familiarity with their regional environments. They have very specific motivations, and good opportunities, to work with private industry in the practical applications of research. In this connection, the provincial organizations have greater freedom than most federal agencies to undertake research contracts for private industry or to engage in joint projects with individual companies. These relationships facilitate the provision of technical assistance where it is most needed, and help to encourage the commercial exploitation of new technology.
5. The advantageous position of the provincial research organizations has been recognized by the National Research Council in the operation of the

Technical Information Service and the Industrial Engineering Service. In provinces with research councils or foundations, these services are operated by the provincial groups with technical and financial support from the national body. This arrangement has been in effect in Alberta for the past 16 years, and has proven very satisfactory. While the program is national in scope, its operations are tailored to the particular needs of each province, and its services reach individual users in the most effective way. It is felt that this program might well serve as a model for co-operation between federal and provincial research agencies in other fields.

6. In comparison with the universities, the provincial research organizations have fewer operational or administrative difficulties in meeting the specific research and development needs of industry or government, since their total mission is research. There is no conflict with teaching or publication pressures, and the work that can be undertaken is not limited by the interests of staff members and graduate students. Projects requiring major amounts of field or pilot plant work can be executed quite readily. Also, most provincial research groups have long been organized on a multi-disciplinary basis, so that there is no need to establish new institutes to undertake interdisciplinary projects. At the same time, it may be noted that several of the provincial groups have close ties with local universities which enable them to serve as connecting links between the university and industry or government. There are many cases in which the establishment of joint programs has been facilitated by the presence of the provincial research groups. Some examples in Alberta are the Petroleum Recovery Research Institute, the Co-operative Highway Research Program, the Hail Studies Project and the Institute of Pedology.*

7. The particular functions of the provincial research groups with respect to private industry are first, to conduct research and development projects on a contract basis, and second, to provide technical information,

* Brief descriptions of these organizations are given in Appendix 2.

industrial engineering services, and other types of assistance with production problems. Contract research services are particularly useful when a company is too small to support its own research facilities, or when it wishes to explore a new line of activity that is outside the scope of its existing research facilities. The availability of such services is extremely important to the Canadian industrial economy, since it enables many companies to undertake programs of innovation and diversification that would otherwise be almost impossible. Further, experience has shown that the provision of these services in no way discourages private industry from establishing its own research facilities as soon as conditions permit; in fact, a successful research project performed by an outside agency is often the best possible way to convince management of the value of a research department to the company. In this same connection, the provincial research groups frequently assist private companies in planning research projects and preparing proposals for industrial research assistance under the various federal programs. Also, they are sometimes able to draw together a group of private companies to undertake research in a new field where no one company wishes to commit itself to a major expenditure; the Solids Pipeline Research and Development Association* is an example of one such undertaking in Alberta which was catalyzed by the provincial research council.

8. In summary, we feel that the provincial research organizations are providing a number of important services that are not duplicated by other agencies, and that could only be provided by other types of organizations at greater effort and cost. In view of the contributions that the provincial research councils and foundations can make in the future toward a strong and effective Canadian research and development effort, we respectfully suggest that steps be taken by the federal government to ensure that maximum use is made of their potential. Some of the principal areas in which we feel that the provincial research groups can contribute to national objectives are in the

* A brief description of this organization is given in Appendix 2.

development of new technology for Canadian industry; the most effective utilization of natural resources, including water and land; transportation; energy sources; pollution control; agrometeorology and weather modification; information dissemination; and aid to underdeveloped countries in such fields as natural resources and industrial development.

9. It must be noted that federal co-operation with provincial research organizations is limited by a number of factors at the present time, particularly in the area of financial support to research projects conducted by provincial organizations. Some of these limitations arise from the specific terms of existing federal legislation. However, there also appears to be a more diffuse problem in certain fields which may arise from concern with federal-provincial relations. In this regard, it should be noted that none of the major research councils or foundations are directly associated with provincial government departments, and that two are completely free of any organizational ties with provincial governments. It is true that some of the provincial research groups give precedence to work originating in their local areas; however, all of them conduct at least a limited amount of work for federal agencies and other organizations outside their own provinces, and could undertake substantially more of this type of work if suitable opportunities existed. In any event, the projects which are conducted by the provincial research groups on a regional basis collectively represent a major contribution to the national economy, and should certainly be taken into account in the over-all research and development policy.

10. A separate study may well be required to establish mechanisms that will ensure the most effective utilization of the capabilities of the provincial research organizations. The following are offered as possible suggestions:

- a) The provincial research councils and foundations should be recognized as a distinctive element in Canada's scientific and technological effort, with a role that is complementary to that of federal, industrial or university research organizations.
- b) There should be acceptance by the federal government of the

value of regional policies toward science and technology, matching these policies to the geographic and economic characteristics of the region. In each of these regions, full advantage should be taken of all existing research and development facilities — industrial, educational, federal, provincial and independent.

c) There should be a continuing effort to decentralize the scientific and technological activities of the federal government whenever it is practical to do so, to improve regional contacts. This decentralization may be accomplished by the establishment of additional regional laboratories by the federal government itself, and also by contracting out federal research programs to other agencies. The latter course has the advantage of encouraging local enterprise and of injecting new ideas and approaches into government operations.

d) Full advantage should be taken of the capabilities and growth potential of existing research organizations before new research groups are established with federal support. When it is found necessary to establish new research groups, this should be done in collaboration with existing research organizations as far as possible, to avoid unnecessary duplication of facilities and services. As an example, the provincial research organizations could advantageously be involved in the planning of any new industrial research institutes at provincial universities.

e) The present avenues of co-operation between federal and provincial research agencies should be strengthened and rationalized, and new avenues explored. Any legislative or administrative barriers to technical co-operation and financial assistance should be eliminated as far as possible; the type of relationship which is now in effect with the National Research Council in the operation of the Technical Information Service should be extended to other fields. Provision should also be made for federal assistance to the provincial research organizations in establishing facilities for new types of industrial technology.

f) Mechanisms should be established that will permit staff exchanges or transfers between federal and provincial research organizations without loss of pension benefits or other rights, so that the special capabilities of staff members may be utilized where they are most needed at any particular time. Short-term exchanges should be encouraged to broaden the experience of staff members and to improve mutual understanding between federal and provincial groups.

Appendix 1

Information on the Research Council of Alberta

History

The Research Council of Alberta was organized in 1921 as an outgrowth of the activities of a committee of university and provincial government representatives which had been appointed to study the economic potential of the natural resources of the province. It was formally established as an Alberta corporation under the Research Council Act of 1930. For a number of years it operated in close association with the University of Alberta and occupied space in university buildings. During the past 15 years the Research Council has acquired its own facilities and has become operationally independent of the University. However, co-operation between the two institutions has continued in a number of fields.

Objectives

The terms of reference of the Research Council of Alberta are broadly defined by the Research Council Act, which states in part that the Council may:

- a) promote in such way as is deemed advisable
 - (i) the utilization of the natural resources of Alberta,
 - (ii) researches with the object of investigating or improving the technical processes and methods that are or might be used in the industries of the Province,
 - (iii) researches with a view to utilizing the waste products of the industries of the Province,
 - (iv) the investigation, at the request of any of the industries of Alberta, of the materials that are or might be used in, or of the products of, the industries making such a request, and
 - (v) researches the objects of which are the betterment, welfare and progress of the urban or rural life in the Province,
- b) have charge and direction of or supervision over the researches that may be undertaken, under conditions to be determined in each case,
 - (i) by or for single industrial firms, or

- (ii) by such organizations or persons as desire to avail themselves of the facilities offered for this purpose.

Organization

The Research Council of Alberta operates under the direction of a ten-member Council made up of three representatives from the provincial government, three from Alberta business and industry, three from the provincial universities, and the Director of Research. Technical advisory committees drawn from industry, universities and government provide assistance with planning and evaluation of research programs. The Research Council staff is organized into various research and service divisions for administrative purposes. However, the boundaries between divisions are kept very flexible so that teams can be assembled to undertake new types of work with a minimum of reorganization.

Staff and Facilities

The full-time staff of the Research Council numbered 210 at the end of 1968, comprising 96 scientists and engineers, 4 post-doctoral fellows, 78 technicians, and 32 technical services and clerical staff. Approximately 75 university students are employed each summer for field parties and other temporary duties.

The main offices and laboratories of the Research Council are located on the campus of the University of Alberta in Edmonton. A pilot plant and laboratory facility for larger-scale research projects is situated in the Clover Bar industrial area near Edmonton. An affiliate of the Research Council, the Petroleum Recovery Research Institute, is located on the University of Calgary campus. A field station is operated each summer at the Canadian Forces Base, Penhold, for hail studies.

Finances

The largest source of financial support for the Research Council of Alberta is an annual grant from the provincial government. Revenue is also obtained from contract research and testing services for private industry, from research projects undertaken for provincial government departments, from federal grants, and from shared-cost projects under the federal-provincial ARDA agreement. The total research expenditures during 1968 were approximately \$2,750,000.

Activities

The principal fields of activity of the Research Council of Alberta during 1969 were as follows:

| | |
|-------------------------------------|---|
| Groundwater hydrology | Chemical process and product development |
| River engineering | Gas separation processes |
| Pavement materials and performance | Hydrocarbon processing |
| Engineering geology | Catalysis |
| Soil mapping and classification | High temperature reactions |
| Hail studies | Carbonization and carbon products |
| Industrial minerals | Sulphur chemistry |
| Coal geology | Fertilizers and agricultural chemicals |
| Petroleum geochemistry | Food processing |
| Oil sands extraction and processing | Microbiology |
| Pipeline transportation | Pulp mill by-products |
| Physical metallurgy | Effluent treatment and water purification |
| Technical information services | Air pollution studies |
| Industrial engineering services | Fuel inspection and analysis |

Publications

A general review of the activities of the Research Council of Alberta is published as an Annual Report. The results of non-confidential work are published in Research Council Reports and Bulletins, and in contributions to the scientific and technical literature. Ten reports and 47 journal contributions were published during 1968. Confidential reports are provided to clients on contract research projects and on other services to individual companies.

Appendix 2

Joint Research Activities in which the Research

Council of Alberta has played a Major Part

The Petroleum Recovery Research Institute conducts research related to the enhanced recovery of oil and gas from underground reservoirs. It is jointly financed by the Government of Alberta and by a group of 37 petroleum and natural gas companies. The Institute has its own full-time staff and equipment, but occupies space in the Engineering Building at the University of Calgary and utilizes various supporting services of the University. Technical assistance, purchasing, personnel and accounting services are provided by the Research Council.

The Co-operative Highway Research Program is concerned with paving materials and soils, with pavement design and performance, and with river crossings. The program is conducted jointly by the Alberta Department of Highways, the Civil Engineering Department of the University of Alberta, and the Research Council. This arrangement takes advantage of the experience and testing facilities of the Department of Highways, the hydraulics, structures and materials laboratories of the Civil Engineering Department, and the special capabilities of the Research Council in organizing and conducting field programs.

The Alberta Hail Studies Project was established to study the causes and behavior of hail storms with the eventual goal of developing effective hail suppression techniques. It is a joint undertaking of the Canada Department of Transport, the National Research Council, and the Research Council of Alberta, with scientific support from McGill University. Assistance is also provided by several Alberta Government agencies, by the University of Alberta, and by the Saskatchewan Research Council. The Meteorological Branch of the Department of Transport furnishes technical staff and equipment for the field project and also provides the greater portion of the funds for basic research at McGill; the National Research Council develops and constructs special equipment for the project such as the

polarized radar facility; the Research Council of Alberta is responsible for the major portion of the field operations and also provides some limited financial support to McGill. In addition to the Canadian effort, several United States teams have worked with the project during the past two seasons as a result of the excellent facilities available for field operations.

The Alberta Institute of Pedology is responsible for soil research in the province, for the collection, interpretation and publication of basic soil data, and for the provision of advice and assistance with land use problems. It is a co-operative undertaking of the Research Branch of the Canada Department of Agriculture, the Soil Science Department of the University of Alberta, and the Research Council of Alberta. The Canada Department of Agriculture and the Research Council conduct the field programs, while the University provides technical assistance, space and laboratory facilities. Graduate students in the Soil Science Department obtain a substantial part of their training through the Institute programs.

The Solids Pipeline Research and Development Association is made up of 22 companies with interests in the fields of rail and pipeline transportation, commodity movement, and pipe manufacture. The Association was formed to conduct research and development work on the pipeline transportation of solid commodities, with particular emphasis on "capsule" transport. All of the work to date has been carried out by the Research Council of Alberta and by private consultants under contract to the Association, but it is possible that the Association may acquire its own facilities in the future. Financial support has been obtained from the member companies, from the PAIT program of the Canada Department of Industry, and from the Alberta Government.

APPENDIX 95

B R I E F

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

BY

THE SASKATCHEWAN RESEARCH COUNCIL

UNIVERSITY CAMPUS

SASKATOON, SASKATCHEWAN

BRIEF

TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

OF THE SENATE OF CANADA

BY

THE SASKATCHEWAN RESEARCH COUNCIL

SUMMARY

At present, it appears that provincial research agencies have no explicitly recognised place in a national science policy.

Since these organisations generally have considerable capabilities in respect to mission-oriented research on local and regional problems, it is contended that provincial research institutions are particularly valuable in meeting regional needs.

We recommend that the special capabilities of provincial research institutions be explicitly recognised in any national science policy. We further recommend that there be mechanisms for extensive and continuing dialogue concerning Federal-Provincial science policies. Simultaneously, a study of the interaction between Federal and Provincial scientific activities should be undertaken leading to the formulation of definitive governing policies.

BRIEF
TO THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
BY
THE SASKATCHEWAN RESEARCH COUNCIL

1. May we commend to the special attention of the committee the brief submitted by Dr. E.J. Wiggins on behalf of the Research Council of Alberta. We unreservedly endorse all its comments and recommendations. Although the specifics of programs differ, it is contended that a common philosophy has generated these undertakings. Rather than dwelling on the similarities between the Saskatchewan and Alberta viewpoints, we devote our attention to some specific matters.
2. Provincial research agencies appear, at present, to have no explicitly recognised place in the national science policy. While Science Council of Canada Report No. 4 identifies roles for federal research establishments, universities, industrial research groups, and private non-profit agencies, no mention is made of provincially-based research organisations.
3. As set forth by statute, the duties of the Saskatchewan Research Council are: " . . . research and investigation into the fields of the physical sciences, pure and applied, as they affect the economy of the Province of Saskatchewan, and such particular matters as may be brought to its attention by the Lieutenant-Governor in Council."
Under these terms of reference, matters under study by the Council are, perforce, mission-oriented. Analogously, other provincial research agencies undertake highly applied research. This emphasis has fostered the development of flexible organisation structure that facilitates the efficient performance of mission-oriented programs.

4. Over a period of 5 years, the Saskatchewan Research Council has been allocated the sum of approximately one million dollars of federal monies under the terms of the Agricultural Rural Development Act (ARDA) to carry out research under the terms of the Act. Annually renewed expenditures totalling this not inconsiderable sum, it is suggested, provide a bona fide demonstration of the efficacy with which a provincial organisation can carry out research in its own territory. In our view, the success of this arrangement demonstrates the desirability of Federal-Provincial dialogue concerning the continuation and expansion of the shared-cost principle in various scientific fields.
5. Since provincial research councils are flexible and mission-oriented, they are, in the main, able to undertake advantageously inter-disciplinary studies on behalf of government and industrial clients. Because of these factors and their terms of reference, provincial research agencies are perhaps more suitable than is industry to undertake investigations involving increased "opportunity" for whole sectors of the economy or segments of the population. Such work may be by-passed by industry because the dollar return to a single operator or a consortium in a limited economic sector may not be sufficient to warrant such studies.
6. Furthermore, we contend that policies explicitly recognising the unique characteristics of provincial research agencies will assist in ameliorating the problem of regional disparity. Not one Saskatchewan-based industry appears to have benefitted under the terms of the Industrial Research Assistance Program*. If secondary industry is to be fostered, it is suggested, a national science policy should make available to provincial research councils in disadvantaged areas the same assistance as is offered to industry. The charge on the councils then would be to use such assistance in mission-oriented research to foster specific industrialisation.

* The Senate of Canada Proceedings on the Special Committee on Science Policy, No. 21, pages 3345-3349.

7. In respect to local and regional problems, provincial research agencies have developed expertise and facilities to treat matters arising in their own particular settings. Due to the diversity of mission-oriented research problems in various parts of the country, considerable specialisation has developed to fill varying needs. It would therefore seem justifiable that a national science policy recognise the intimate knowledge of and concern for local problems shown by the provincial research organisations. Part of such recognition would include maintaining and utilising provincial agencies through contractual, shared-cost, and grant-in-aid mechanisms.
8. In view of the considerations enumerated above, we suggest that, the ubiquitous nature of science dictates that any viable federal science policy contain a mechanism for establishment of dialogue between Federal and Provincial governments in order that both levels may discharge their various responsibilities in an effective and efficient manner. Coincident with the establishment of such dialogue, an intensive study of the inter-relationships between Federal and Provincial science policies should be undertaken.
9. Through the years, a very significant part of Canada's external aid program has been the provision of highly trained specialists to organise programs in the developing nations. Provincial research institutions constitute a pool of scientific manpower thoroughly familiar with mission-oriented research, particularly in resources management areas, and should be recognised as sources of potentially desirable candidates for international development assignments.

Appendix 1

Information on the Saskatchewan Research Council

History and Duties

The Saskatchewan Research Council was established by act of the Provincial Legislature in 1947 because it was apparent that the increasing and pervasive importance of science and technology presented the province of Saskatchewan with new opportunities and new challenges. The duties of the Council, as specified by the Research Council Act* and quoted in paragraph 3 of this submission, are interpreted as directing the Council to:

- " operate as a center of knowledge concerning the technical aspects of provincial resources and industrial activities;
- " provide the government with information to be used in formulating development and conservation policies;
- " act, when required, in the capacity of research and development branch of provincial government departments and Crown corporations;
- " participate with other agencies in the search for new natural resources;
- " investigate methods for industrial utilisation of natural resources;
- " assist industry in technical matters.

From 1947 to 1958 the Council had neither research staff nor facilities and carried out some of its objectives by providing grants and scholarships to the University of Saskatchewan for mission-oriented projects. While this arrangement is highly productive of new ideas and still constitutes a significant portion of the Council's program, it has the following limitations, as enumerated in the 1958 Annual Report:

- " " the work can not easily be intensified upon the most urgent or important projects;
- " the program can not be expanded according to need but is dependent in magnitude on the availability of graduate students;
- " it is difficult to organise projects that require participation of two or more academic disciplines;

* RSS C. 406 S. 10

" it is often difficult to continue a research project through development to application."

Accordingly in 1958, to complement the University program, a research laboratory was provided on the University Campus in Saskatoon and permanent staff were recruited.

Organisation

The Saskatchewan Research Council is a body corporate. Its governing Council is chaired by the Minister of Education and consists of not more than 21 members representing industry, government, and University in roughly equal proportions.

Scientific staff, under a Director, are organised into divisions of Chemistry, Engineering, Geology, Physics, and Industrial Services, each under a Division Head. There is, however, considerable crossing of divisional and disciplinary boundaries to cope with the multidisciplinary aspects of mission-oriented programs.

Staff and Facilities

The full time staff of the Research Council as of April 1, 1967 numbered 85, about half of whom were scientists and engineers. Other temporary staff, consisting mainly of University students, and employed largely during the summer for field programs, number approximately 25.

The main laboratory is located on the Saskatoon Campus of the University of Saskatchewan. Additional Engineering Laboratories are located in Saskatoon. Various field observation facilities are located on other University property and at selected points throughout the settled part of the Province.

Finances

The Research Council Act empowers the Council to administer its own finances from the Saskatchewan Research Council Fund.

The operating expenditure for the year ending March 31, 1969 totalled approximately \$1,500,000. While the main source of financial assistance is a grant from the Government of Saskatchewan, the Council is encouraged to augment this by:

Special Committee

- " contract research work with industry and government departments
eg. the potash industry
- " research development grants with industry and government departments
eg. Canada Department of Agriculture
- " Federal-Provincial shared cost programs. eg. ARDA directly, and
PAIT indirectly.

Activities

The activities of the Saskatchewan Research Council are reported, briefly in its Annual Report, by journal publication, by Research Council publications, both open and confidential.

The principal studies involve activity in:

| | |
|-------------------------------------|---------------------------------|
| Potash Utilisation | Groundwater Hydrology |
| Water Quality and Desalinisation | Geochemistry |
| Lignite Research | Urban Physical Environment |
| Carbon and Tritium Dating | Technical Information Services |
| Chemical Analyses | Industrial Engineering Services |
| Solution Mining of Potash | Precipitation Physics |
| Ceramic Studies | Aerosol Physics |
| Pipeline Transportation of Slurries | Agrometeorology |
| Surface Water Hydrology | Geophysical Prospecting |
| Groundwater Geology | Instrumentation Physics |

APPENDIX 96

BRIEF

Presented By

ONTARIO RESEARCH
FOUNDATION

To The

SPECIAL COMMITTEE
ON SCIENCE POLICY

Senate of Canada

March
1969

B R I E F

Presented By

THE ONTARIO RESEARCH FOUNDATION

to the

SPECIAL COMMITTEE ON SCIENCE POLICY

The Senate of Canada

March, 1969

Ontario Research Foundation, Sheridan Park, Clarkson, Ontario, Canada

BRIEF TO THE SPECIAL COMMITTEE ON SCIENCE POLICY,
OF THE SENATE OF CANADA

by

THE ONTARIO RESEARCH FOUNDATION

SUMMARY

- (i) The Ontario Research Foundation is a multi-disciplinary applied research institute which undertakes work, under contract, for industrial and governmental clients. It is not a department, agency nor commission of the Ontario Government, but is an independent corporate body operating in the public interest.
- (ii) The Foundation was established in 1928 by the joint efforts and equal financial contributions of Canadian industry and the Ontario Government. Since its establishment, the Foundation has grown steadily in physical size and industrial esteem, and now provides more direct assistance to Canadian industry than any other research institute in the country. Recently the Foundation played a leading role in the initiation and development of the Sheridan Park Research Community. Again, as in 1928, Canadian industry and the Ontario Government participated cooperatively and shared the cost of O.R.F.'s new buildings in Sheridan Park.
- (iii) O.R.F.'s clients pay the full costs, including overheads and depreciation, of work done on their behalf. All work is confidential and all patent rights arising from the work are assigned to the client. Thus the cost and benefits to the client are as though the work had been conducted in his private research laboratory.
- (iv) All Canadian companies and government establishments can avail themselves of O.R.F.'s services on the same financial basis. Foreign companies and foreign government agencies are not given the same privileges as Canadian companies; to merit consideration the work involved must contribute to the Foundation's ability to serve Canadian industry and, in addition, extra compensation is required by way of increased fees or of the basic research content of the project.

(v) The nature of the work done at O.R.F. is essentially applied research. This is the research area which needs to be expanded in Canada to-day. Although it is virtually impossible to measure the true economic value of any type of research project, there is strong evidence (see Para. 21) that some of O.R.F.'s work has significant economic value to Canada. In general, the type of work undertaken by O.R.F. is directed specifically to economic or social goals. In this respect O.R.F.'s contribution to general economic well-being tends to be much higher per dollar expended than at any other type of research institution.

(vi) It is estimated that the availability of contract research facilities is of most importance to the top 20-25% (by company size) of Canadian companies. For most of the firms in this group, the services of a contract R.&D. organization are essential, for such services are the only means by which medium-sized firms can embark on programmes of innovation leading to new or improved products and processes. Furthermore, with the rising complexity and cost of R.&D., and with the increasing technological content of goods, it can be expected that industry's need for contract R.&D. facilities will grow rapidly in the future.

(vii) There are several factors which must be accommodated in a multi-disciplinary contract research facility if it is to be both effective and efficient. Basically, the scientific staff must be strongly oriented towards applied research and the internal organisation of the institute must be designed specifically to ensure the routine accommodation of confidential R.&D. projects. In addition, to maintain the scientific competence of the staff application-oriented basic studies must be undertaken, and to maintain the continuing effectiveness of the organisation a competence in all newer technologies of industrial significance must be acquired. Effectiveness can also be enhanced if funds are available for the preliminary investigation of internally-generated ideas which show promise of subsequent industrial use, and for the development of procedures by which research opportunities can be brought to the attention of appropriate companies or industries.

(viii) At present O.R.F. total staff numbers about 250, of which about 40% are graduate scientists and engineers, about 35% are technical support staff, and about 25% are administrative and maintenance personnel. Total income from all sources is now (1968 figures) about \$3.5 million, of which approximately 70% is for work done under contract for various clients, and 30% is non-contract income. The non-contract income consists of the Endowment income (15%), an Ontario Government Grant (83%) and a Federal Government Grant (2%). Most of the contract income is from industrial sources (54%). Of the remainder, some 11% is from Federal Government sources.

(ix) The amount of the Ontario Government grant is equivalent to O.R.F.'s contract income from Canadian industry. This "industrial income" basis was as suggested by O.R.F. because of its practicability. First, it provides for back-up research and those other activities which must be undertaken in proportion to the amount of industrial work done. Second, it provides a powerful incentive to the Foundation to concern itself with those R.&D. activities that have immediate industrial application.

(x) The Foundation's operations could be made more effective than present income permits. The Ontario Government grant ensures the future viability of O.R.F.'s operations. However if the Foundation is to serve industry with maximum effectiveness, additional funds are necessary to enable O.R.F. to develop skills and facilities in the newer industrial technologies. It is certainly in the interests of the Federal Government that essential technological services are readily available in Canada's most heavily industrialised area.

In terms of O.R.F.'s total income, and in view of the vast sums expended in support of research by the Federal Government, the present \$25,000 Federal Grant to O.R.F. is, to say the least, token support. In view of O.R.F.'s recognised value to industry in this country, and the Canada-wide coverage of the Foundation's operations, it is difficult to understand the Federal Government's failure to provide greater direct support for O.R.F.'s operations.

Special CommitteeBRIEF TO THE SPECIAL COMMITTEE ON SCIENCE POLICY,
OF THE SENATE OF CANADA

by

THE ONTARIO RESEARCH FOUNDATION

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INTRODUCTION

1. Any broad investigation of Canadian Science Policy must take into account the activities of each of the Provincial Research Institutes. There are six such institutes in Canada today and, although their activities, operations, and organisational structures are by no means identical, they are, in general, all concerned with the application of science and technology to the industrial and natural resources of their particular provinces. They play an important and meaningful role in the total R&D picture.
2. The Ontario Research Foundation is one such institute. It is by far the largest of the Provincial Research Institutes and, since it is located in Canada's most heavily industrialised province, its operations have a much more significant impact on Canada's industrial sector than any other research institution in North America. This fact was clearly indicated by an independent study undertaken by the Canadian Manufacturers Association.*
3. It is important, therefore, that those charged with investigating and advising on national research policies have a clear understanding of all aspects of the Ontario Research Foundation. This understanding, it is hoped, will not only help to complete the picture of Canada's overall R&D structure, but may provide new ideas on institutional operations which may be applied elsewhere. Also, it is hoped that a complete understanding may stimulate closer relationship between the Ontario Research Foundation and Federal Government Departments and Agencies, particularly those concerned with the promotion and sponsorship of industrial R&D.

* See para. 21 of this report.

ORGANISATION

4. The Ontario Research Foundation was established in 1928 by the joint efforts of Ontario's industry and Government. Each subscribed \$1.6 million toward the setting up of this independent, non-profit, research institute, which was to engage in R&D activities relating to industrial products and processes and to the natural resources of the Province. The Foundation is a body corporate operating under a special Act of the Ontario Legislature which outlines the Foundation's objectives and modus operandi. A copy of this Act is attached (Exhibit 1).

5. A Board of Governors consisting of up to 25 representatives of industry, science and the universities is directly responsible for the management of the Foundation's affairs. Although Board Members are officially appointed by the Lieutenant-Governor-in-Council of the Province of Ontario, the practice so far followed has been for the Government to accept the recommendations of the existing Board when appointing new Members. Members of the Board are appointed for a period of 5 years, and are eligible for reappointment at the expiration of this term. They are not paid any remuneration for their services, except for reasonable expenses. The present Chairman of the Board is Mr. J. D. Barrington, a leading Canadian industrialist. The names of all Board Members and their affiliations are contained in the Appendix.

6. The President of the Foundation is appointed by the Board and is the Foundation's principle administration officer, responsible for the general management of the Foundation.

7. Internally, the Foundation's organisational structure can be separated into two groups - the large scientific and technical group, and a much smaller administrative group. The first group, consisting of nine scientific and technical departments each managed by a Departmental Director, is under the direct supervision of a Director of Research who, in turn, reports to the President. The second group consists of four sections - Treasurer's Office, Secretary's Office, Project Development and Corporate Relations - each of which reports to the President directly.

The nine scientific and technical departments are:-

- | | | |
|----------------|-------------------------|--------------------------|
| (1) Textiles | (2) Organic Chemistry | (3) Engineering |
| (4) Physics | (5) Physical Chemistry | (6) Applied Microbiology |
| (7) Metallurgy | (8) Materials Chemistry | (9) Field Services |

A block diagram representative of the organisational structure is shown in the Appendix (Fig. 4).

ORGANISATIONAL FUNCTIONS(A) FORMAL OBJECTIVES

8. A detailed description of the Foundation's statutory functions and powers regarding scientific activities is contained in the "Research Foundation Act, 1944" (Exhibit 1). However, with the passage of years and the increased emphasis being placed upon research today, the areas of research which can best be served by the Foundation have become more clearly delineated. Certain pursuits, for example, although contained in the Act, are now being adequately covered by research in the universities and Departments of Government and no longer demand effort and expenditure by ORF. As a result of these changes and changes in the economic structure of Ontario particularly during the past two decades, the purpose and aims of the Foundation can be redefined in terms more pertinent to present day circumstances.
9. Any such clarification or re-definition of ORF's objectives must, of course, take full cognizance of the interests of the Foundation's two sponsors, Canadian industry and the Ontario Government, and the first embracing requirement is to provide an effective research facility, including both staff and equipment, for their use and benefit. In the operation of that facility, it is necessary that all work performed must be fully paid for by the party requesting it. Essentially then, the Foundation must conduct itself as a contract research organisation primarily serving the needs of Canadian industry and Departments of the Ontario Government.
10. A re-definition of the assigned objectives in the existing Act, so that the formal obligations conform more closely to the actual role of the ORF today in Ontario's economic development, is under consideration involving a modification of the present Article 3 to read as follows:-

"The objectives of the Ontario Research Foundation shall be to contribute to the development of the Province through the techniques of scientific research and of development by:

- (i) Providing a research and development staff and facility for the benefit of industry, commerce and Government within the Province, and
- (ii) Carrying on scientific research, development, and other scientific and technical studies, investigations and activities particularly those having for their objects,
 - (a) the development, utilization, or conservation of the resources of the Province,
 - (b) the improvement and development of industrial materials, products, processes and techniques,for industry, commerce and Government upon terms and conditions determined on a non-profit basis consistent with the necessity of maintaining the viability of the Foundation,"

(B) RESPONSIBILITIES

(i) To Industry

11.

Under Article 3 of the Foundation Act, both in the existing form and in the suggested modified version, ORF's responsibilities to industry are very broadly defined. Because ORF receives an annual grant from the Province, it follows that industry in Ontario should, wherever possible, be given preference in any decision concerning the Foundation's range of activities and in any resulting industrial opportunities. However, it is often quite difficult to classify a Canadian company as being clearly an Ontario company or a non-Ontario company. With the approval of the Government of Ontario, it is the policy of the Foundation to make its facilities available to all Canadian companies on the same financial terms. The only difference that exists is that first priority is given to an Ontario company, whenever this is possible, with respect to research opportunities resulting from work supported by Provincial funds.

12. Foreign companies (and foreign Government Agencies) fall into a quite different category - they are not given the same privileges as Canadian companies. This is to be expected in view of the purpose and constitution of the Ontario Research Foundation, and the fact that ORF's basic activity is assisted by the Provincial Government. Contract work for foreign sponsors is undertaken only under special circumstances and under conditions which have some meaning in terms of a Canadian institution dedicated to serving Canadian interests. To merit consideration, the work involved must contribute to the Foundation's ability to serve Canadian industry, and its conduct must contribute either directly to the basic skills of the Foundation by virtue of its basic research content, or indirectly by an appropriate increase in the fees charged.

(ii) To Departments of the Ontario Government

13. The "Research Foundation Act, 1944" recognizes the importance of research in the development of natural resources and a major objective of the Foundation is stated as:-
- "The carrying on of research studies and investigations, particularly those having for their objects the conservation, development and utilization of the natural resources of the Province."
- In addition to the natural resource field, Provincial Government research is concerned with other areas of development, for example, highways and health. In the following discussion, these various areas of Provincial responsibility are referred to as the resources of the Province.
14. Overall responsibility for the resources of Ontario rests with the Provincial Government, and the various activities which relate to development, conservation and utilization of a particular resource, including research and development, are under the control of the appropriate Department of Government concerned with that resource. The needs of different Government Departments regarding research and development are met either by maintaining a suitable research facility within a Department itself or by arranging for some other organisation, such as the Foundation, to undertake the required work on its behalf.

15. Where the scientific research requirements of a Department are very extensive as, for example, in the Ontario Department of Agriculture, it is more efficient and in all respects better that the research effort be fully incorporated into the Department itself and form part of it. For most research and development operations, however, there is a certain size below which it is uneconomical and often ineffective to operate as a separate unit. Wherever this is the case, or where for other reasons a Department prefers that its research studies should be carried out by an external body, the Foundation may be called on to provide the necessary scientific base and facilities for the required investigations.
16. There are very compelling reasons why research and development in the resource field should be closely associated with the Provincial Department concerned. While there are an almost unlimited number of problems bearing on resource development, the funds available for their solution will always impose limits on the amount that can be done. An important consideration, therefore, is the selection of goals which will yield the most benefit to the Province for the funds expended. In selecting these research objectives and placing a priority on them, the important decisions must be made by departmental specialists who are expert in the particular resource area and who are intimately aware of the extent and nature of the problems in the field. Moreover, to be of economic value, research must be put to use, and this responsibility for application of knowledge in the resource field lies with the particular Government Department concerned.
17. Essentially then, the role of the Foundation with respect to Ontario Government R&D is to assist each Department to discharge its responsibility for a particular resource by undertaking, when requested, scientific research and development on its behalf. The individual Department provides the funds necessary to pursue the research studies it requests. The Foundation further assists wherever possible by suggesting research and development programmes for Departmental consideration and decision.

Special Committee(iii) To Federal Government Agencies

18. At this time the Foundation has relatively little inter-relationship or direct contact with Federal Government Agencies. The Foundation is the Ontario agency for the Technical Information Service of the National Research Council and, in addition, the Foundation receives a grant of \$25,000 annually from NRC. Contract research work has been undertaken for Departments of the Federal Government in the past and, in general, this has been of mutual advantage. All such work has been fully paid for and, particularly in the case of the Department of National Defence, has been undertaken in the interests of Canada without reference to its contribution to the Foundation's skills.

19. There are many areas in which there is an intimate and direct overlapping of Federal and Provincial research responsibilities and interests. In view of these mutual responsibilities and in view of the major significance of Ontario to the economy of the nation as a whole, some Federal support of research activities at ORF would be warranted and would be a proper expenditure of Federal research funds. As mentioned above, the Foundation does not restrict its activity to Ontario. All Canadian companies are given the same consideration without reference to their location, and Federal Government Departments can avail themselves of ORF's services on the same basis as Ontario Government Departments. It is appropriate, therefore, that the Federal Government should assume some of the financial responsibilities of providing this contract research service to Canadian industry and Federal Government Departments.

OPERATIONAL EFFECTIVENESS

20. During the decade 1958-68 about 3,500 firms spent in excess of \$9.0 million on research and development at the Foundation, and the annual industrial volume increased from \$475,000 to \$1.3 million. This amount represents a very large proportion (approximately 2/3)* of industry's total expenditures on contract research in Canada.

21. A study made by the Canadian Manufacturers Association** reflects the effectiveness of ORF's industrial research efforts. Of 381 Canadian companies reporting research activities, more than half availed themselves of outside help (Government research centres, universities etc.) for assistance in specialised research programmes. The most frequently mentioned sources of such assistance were:

| | | | |
|---------------------------------|----|-------------------------------|---|
| ONTARIO RESEARCH FOUNDATION | 62 | McMaster University | 5 |
| National Research Council | 38 | Arthur D. Little (USA) | 5 |
| Dept. of Mines & Techn. Surveys | 18 | University of B.C. | 4 |
| B.C. Research Council | 18 | Dom. Experimental Farms | 4 |
| Pulp & Paper Research Inst. | 16 | Dept. of Agriculture, Ottawa | 3 |
| University of Toronto | 9 | University of Alberta | 3 |
| McGill University | 9 | Atomic Energy of Canada | 3 |
| Forest Products Lab. | 9 | Batelle Memorial Inst. (USA) | 3 |
| University of Montreal | 6 | University of Western Ontario | 3 |
| Alberta Research Council | 5 | Queen's University | 3 |
| University of Manitoba | 5 | Naval Research Establishment | 2 |

22. While the data presented are a measure of the effectiveness of ORF, it is more significantly, when viewed in total, a measure of the importance of contract research in industrial development.

* Estimated from data given in "Industrial Research and Development Expenditures in Canada 1957, 1959, 1961, 1963" D.B.S.

** "Industrial Canada", October, 1961

23. The usefulness of a contract research organisation to industry is described in a recent O.E.C.D. report* in the following way:-

"Sponsored research institutes provide know-how and research capacity in the fields where industrial firms have neither the need nor the time to build up a permanent competence of their own. Thus they increase the flexibility of a country's capacity for industrial research."

24. The value to Canada, as distinct from the value to the sponsoring company, which can result from a contract research programme is well illustrated by work carried out by the Foundation for The Ontario Paper Company. In describing this work, Dr. C. A. Sankey, Vice-President - Research, The Ontario Paper Company Limited, stated:-

"It is thus evident that the Ontario Research Foundation, through the availability of highly competent staff and of equipment not at the time readily available to The Ontario Paper Company, not merely provided a service but made a vital contribution to a research effort carried on in this Province, which effort matured into a new industry which utilizes natural resources previously wasted and which makes a significant contribution to the economy of both Canada and Ontario."

This industry, which was developed by The Ontario Paper Company, now (1964 figures) produces over \$4 million of goods annually, of which over \$3.9 million are exported. At least 70 men are regularly employed, with an annual payroll of \$340,000. In 1964, the consumption of raw materials and supplies purchased in Ontario alone amounted to over \$1.6 million. The contribution to the economy of this country resulting from this study is substantial: the annual tax revenues generated at all levels of Government have been estimated to be about \$400,000 based on 1964 figures.

* "Government and Technical Innovation", O.E.C.D. 1966

25. Another strong indicator of industry's continuing high regard for the Foundation is the fact that Canadian industry has recently subscribed almost one million dollars toward the cost of ORF's new building at Sheridan Park. Based on industry's response to date it is expected that a further substantial amount will be forthcoming from industrial sources. It is significant that these contributions are entirely voluntary and may be regarded as a direct acknowledgement of ORF's value to the industrial community at large.
26. In recent years, ORF has taken measures to increase further its usefulness to industry. The Foundation no longer relies entirely on industry to initiate sponsorship of research projects. A special department has been set up which now co-ordinates suggestions from the scientific staff of potentially useful avenues of study for sponsorship by industry, and subsequently brings these ideas, in the form of research proposals, to the appropriate companies.
27. In another direction in order to help strengthen industrial research activity in this country, the Ontario Research Foundation played a leading role in the initiation and development of the Sheridan Park Research Community, located 17 miles west of Toronto. Research laboratories costing about \$35 million and employing in excess of 1700 people are now in operation.

MEETING FUNCTIONAL OBLIGATIONS

- 28, As has already been outlined, the Foundation's main objective is to provide a well-staffed and well-equipped contract research facility for the use of industry and Government. The means by which ORF can and does meet the research needs of individual Departments of the Ontario Government with respect to Provincial resources has been discussed. The means of fulfilling the research needs of industry, however, require more detailed explanation. Before any attempt can be made to satisfy industry's needs it is necessary to understand what these needs are, and then to select the most effective means of satisfying them within the limitations imposed by financial and other considerations.

(A) THE RESEARCH NEEDS OF INDUSTRY

- 29, In common with any industrialised community, the range of industrial operations within Canada covers a very broad spectrum and the size of individual firms ranges from small to very large. This, in turn, means that the technological needs of the industry will also cover a broad range embracing virtually all scientific disciplines and varying in scientific depth from the pursuit of advanced scientific studies to the simple provision of known technical information.
- 30, In general, very large companies have their own research and development groups but, even so, the services of a contract research organisation are often required to assist them. These occasions arise when a company wishes to undertake a study that is outside its normal field of specialisation or when it is contemplating diversification. In addition, a contract research body provides a company with an opportunity to avail itself of possible new ideas from a fresh appraisal of a problem, and to accommodate varying demand loads on its own research facilities.
- 31, The smaller companies are in a quite different position and must depend on outside sources for technological assistance and information.

Below a certain size, companies cannot afford to build and maintain private research laboratories, nor would it be wise to do so. At least 95% of companies in Canada fall within this category. The development of a worthwhile research facility is quite costly, and as research becomes more sophisticated, the more expensive it becomes to pursue, and the further beyond the reach of the individual company to maintain as a private operation. Furthermore, a small research group working in isolation has a greatly reduced potential in today's scientific climate. However, there are many of these smaller companies that, although unable to support their own private research team, can afford to sponsor a research programme to be carried out on their behalf at a contract research organisation. Between 15 and 20% of firms fall in this category. To these companies the availability of a competent contract research body to which they can turn for assistance is of vital importance.

32. For these larger firms then (20 - 25% of the total), the Ontario Research Foundation fills an essential need by providing contract research facilities which can be called on as and when required. This group of companies produces at least 85% of Canada's total manufacturing output and employs 80% of the manufacturing labour force. It is primarily on companies in this size range that Canada must rely for the industrial expansion necessary for sustained economic growth.

33. It is to be expected that the usefulness of a contract research organisation to industry will increase with time. The reasons for this are: the size of the group capable of employing research will increase as industry expands; the increasing sophistication of research will result in fewer firms being able to support a private research facility; firms will be forced to turn more and more to research to maintain a competitive position as technology advances. Consequently the provision of contract research facilities by the Foundation to this vital segment of industry will continue to be of major importance.

4. The technical needs of the lower 75-80% (by company size) of manufacturing firms do not, as a rule, extend to contract research. Besides being limited by the cost of research, members of this group are sometimes not in a position, technologically nor financially, to make effective use of the results of a research programme. The assistance they require can be classified broadly into technical evaluation of products and materials, the investigation of production problems, technical advisory services and technical information. To many small companies help of this type is very important, and although not research, the Foundation has considered it a very necessary and valuable service which it should and does provide. The number of short-term laboratory investigations which are undertaken by the Foundation in rendering assistance of this type runs well over 1,000 each year.

35. Provision of technical information is an aid of particular importance to small companies, and such a service was initiated by the Ontario Government at the request of the Canadian Manufacturers Association. In this connection the Foundation provides technical information and field services to industry without charge as the agent of the Ontario Department of Trade and Development and as the Ontario representative of the National Research Council. It is, however, an activity which, by the nature of the service, must remain the direct responsibility of Government and not of the Foundation.

(B) THE MAJOR FACTORS GOVERNING EFFECTIVE PERFORMANCE

36. An institute which undertakes contract research projects for individual clients must, of necessity, accept a responsibility for safeguarding the private interests of its clients. This principle is of the utmost importance in all industrial contract arrangements, since the nature of the work invariably relates to the client's private operations, and its disclosure could bear heavily on his competitive position. Also, if the objective of the institute is to contribute to the general well-being and development of industry, then well-designed and equitable

policies must be adopted governing the disposition of patent rights and the method of charging clients for work done. Such policies must conform to the principle that the client's interests are paramount, and be restrictive only to the extent that they do not limit the future effective performance or viability of the institute,

37. Hence, contract research projects undertaken by the Foundation on behalf of industrial clients are always regarded as strictly confidential by the Foundation's staff, and all patent rights arising directly from these investigations are assigned to the sponsor. The Foundation's method of charging clients for contract work is designed to recoup the full cost of the work done, including overhead and depreciation. These charges are currently assessed as the sum of the following:

- (a) The amount paid by way of remuneration to the scientific and technical staff assigned directly to the project, part-time services being pro-rated;
- (b) 115% of the amount under (a) - to cover all undistributed costs, overhead expenses, and depreciation;
- (c) All other direct costs including materials, supplies, special equipment, specialised services and travelling expenses.

38. This method of charging clients differs from that used by most Government and university laboratories undertaking contract research, in that it involves no subsidisation of the work done. Indeed the costs and benefits for work done at ORF for a client are essentially the same as those for work done in his own laboratory.

39. In a contract research organisation, the most important consideration affecting the continued performance of industrial research at a high level of quality and competence is the need for a proper balance between basic research studies and the contract work in progress in the

laboratories. The importance of the balance is discussed in a recent O.E.C.D. report:*

"When applied research and development are carried out away from an atmosphere of basic research and too closely geared to production, they tend to concentrate more and more on the refinement or elaboration of old ideas and methods,..... Furthermore, with the increasing complexity of technology and its direct dependence on fundamental discovery, closeness to original work becomes necessary to maintain the required level of sophistication.

Provision of funds and apparatus to make this possible, is an excellent investment in helping to ensure eagerness, awareness, scientific versatility as well as a higher standard of recruitment, which can hardly fail to produce a better applied research project."

The Foundation is keenly aware of this need to maintain an adequate amount of application-oriented basic research work as part of its scientific activity. Not only does this basic research provide a background of information necessary for applied studies on specific industrial problems, but it is also essential in maintaining the competence of the scientific staff and the Foundation's ability to attract and retain good scientists. Industrial contracts, which are generally directed to attain particular objectives, do not normally involve extended basic studies. It is these basic studies, however, on which the successful conduct of contract research largely depends. Because of the growth of its industrial contract demands, the Foundation is faced with the requirement of finding sufficient resources to provide the amount of basic work considered necessary. If scientific competence of a high order is to be maintained, the amount of basic research work carried out places an upper limit on the amount of industrial contract work which the Foundation can competently undertake to carry out.

* "Fundamental Research and the Policies of Government", O.E.C.D., Paris 1966

40.

There are other factors in the operation of a contract research organisation which bear upon the effectiveness of research as an instrument of industrial progress. A contract organisation operating essentially in the public interest and serving all segments of industry should provide adequate facilities and a competency in all those technological areas which are of prime importance to the industries concerned. This obviously requires a broad spectrum of skills and activities, broader than the Foundation has so far been able to sustain. Further, it is desirable that an applied research institution such as ORF should be looking ahead and developing a competence in those new technologies which show promise of becoming important, and thereby be in a position to assist in their application to industrial processing. To expand scientific activity into all major fields of present and potential importance to industry in Canada or Ontario would, however, require considerably larger financial resources than the Foundation possesses at the present time. It is an objective which nevertheless must be maintained in view if the Foundation is to be, in a real sense, fully effective in its role as a scientific arm of industry.

41.

Provision must also be made for undertaking preliminary investigations on potentially useful ideas which can subsequently be brought to the attention of industry for further development. Not all ideas, of course, when subjected to more protracted scientific examination prove to possess the practical value and promise which the initial concept suggested, and provision has to be made to absorb the costs of these feasibility studies. This type of preliminary investigation is, however, very necessary in promoting the application of new ideas to industry, and an inability to pursue such work would place a definite limitation on the value of the Foundation's efforts. Such work is a necessary part of the operation of a research institution designed to be effective in its aid to industry.

Special Committee

42. In a similar way, to ensure that worthwhile research and development possibilities are brought to the attention of industry, staff must be maintained whose function it is to recognise and delineate industrial implications of the various research activities, and subsequently draw up and submit research proposals to appropriate companies for their consideration. This activity is being pursued by the Foundation to a limited extent, but greater effort should be made along these lines to encourage a growing participation by industry in research.

43. As explained later, the Ontario Government provides ORF with an annual grant to help cover the cost of these basic requirements. However, in view of the nation-wide availability of ORF's services, responsibility for financing these costs should not rest with the Province alone; Federal Government support is both justified and necessary if the Foundation is to contribute most effectively to economic growth.

FINANCIAL AND PERSONNEL DATA(A) FINANCIAL

44. The trends and sources of income of the Foundation from 1930 to 1968 are presented in diagrammatic form in Fig. 1 of the Appendix. This diagram shows the two main division of income: non-contract income, and contract income. The non-contract income is used to provide the "back-up" research, as explained previously, and those other phases of activity necessary for the maintenance and development of a contract research institute operating in the public interest.

45. During 1968 non-contract income constituted about 30% of the income of the Foundation. The sources of this non-contract income were as follows:-

| | |
|-----------------------------------|-----|
| Province of Ontario (grant) | 83% |
| O.R.F. Endowment Income | 15% |
| Federal Government (N.R.C. grant) | 2% |

Contract income in the same year amounted to 70% of the total and was derived from the following sources:-

| | |
|-----------------------|-----|
| Canadian Industry | 54% |
| Provincial Government | 28% |
| Federal Government | 11% |
| Other | 7% |

46. During the early years of the Foundation the fund provided for the necessary back-up research. In later years the endowment income has become entirely inadequate for this purpose, providing less than 5% of the total income of the Foundation. Perhaps it should be mentioned that the endowment consists of the original funds subscribed by industry and the Ontario Government (see Section 2) and that this endowment is still intact to-day.

47.

During the past two decades the Province of Ontario has provided funds for this necessary "back-up" research. Since 1967 the funds so provided by the Province for "back-up" research have been equal in amount to the income earned by the Foundation from Canadian industrial sources. This basis of determining the size of the grant was suggested by the Foundation and accepted by the Province. Industrial income was chosen primarily because of its practicality. It is related directly to the cost of maintaining an effective contract research facility for industry and Government and also to the contribution that ORF actually makes to the economy of the Province. Furthermore, it provides a powerful incentive to the Foundation to concern itself with those research and development activities that have immediate application.

48.

Except for an annual grant of \$25,000 from the National Research Council, the Foundation receives no direct financial support from the Federal Government. In view of the vast amount of money expended on research by the Federal Government and the relative contribution which ORF is making to the development of industry in this country, this situation is, to say the least, anomalous. There is an obvious need for contract research institutions in the industrial framework of this nation. ORF fills this need and, since ORF is not a Department nor Agency of the Ontario Government, the Foundation cannot expect the Ontario Government to be exclusively responsible for financing all the Foundation's essential basic activities. It would appear only reasonable to expect the Federal Government to provide funds to the Foundation to ensure the maximum effectiveness of its operations.

(B) PERSONNEL

49. At present (December 31st, 1968) ORF's total staff numbers 247. Of these, 99 are science and engineering graduates, 87 are technical support staff, 59 are administrative and maintenance personnel, and 2 are temporary staff. Over the last seven years, annual turnover among the scientific staff has averaged 17.6%. In terms of academic qualifications the present scientific staff can be categorised as follows:-

Ph.D. - 32

M.Sc - 18

B.Sc - 49

Statistics on staff from 1962 to 1968 are as follows:-

| <u>Year</u> | <u>Scientific</u> | <u>Technical</u> | <u>Admin.</u> | <u>Temporary</u> | <u>Total</u> |
|-------------|-------------------|------------------|---------------|------------------|--------------|
| 1962 | 97 | 74 | 31 | 8 | 210 |
| 1963 | 98 | 86 | 35 | 8 | 227 |
| 1964 | 104 | 92 | 41 | 7 | 244 |
| 1965 | 95 | 90 | 43 | - | 228 |
| 1966 | 90 | 81 | 47 | - | 218 |
| 1967 | 98 | 84 | 61 | - | 243 |
| 1968 | 99 | 87 | 59 | 2 | 247 |

DISCUSSION

50. No other organisation in Canada has the same range or combination of responsibilities and financial structure as the Ontario Research Foundation. It is, therefore, most appropriate for those charged with formulating and establishing national science policy to examine the role of such an institute in the overall research and development structure of Canada today, first to make certain that it has a legitimate and effective place among the many existing institutions and second, to ensure that it can and does perform efficiently and effectively within its range of responsibilities.
51. ORF is essentially a contract research institute. Because of the very nature of contract research, particularly with regard to the strictly confidential aspects of the work undertaken, it is difficult for any other type of research organisation to undertake contract research effectively. The high rating of ORF in the industrial survey made by the Canadian Manufacturers Association* confirms this view. The successful undertaking of contract research requires that the scientific staff be strongly oriented to applied research, particularly to resolving the practical problems of industry. Frequently, scientists engaged in other types of research find great difficulty in adjusting to this requirement. Furthermore, the internal organisation of a contract research institute differs from that of other research institutes in that it is project oriented so that confidential multi-disciplinary research can be carried out effectively and efficiently.

* See para. 21 of this report.

52. Industry's need for contract research facilities is evident from the growing industrial expenditures at ORF and at other similar institutions. Indeed, contract research institutes, such as ORF, offer the only opportunity for small and medium-sized companies to engage in proprietary R&D. Furthermore, there is every indication that the dependence of industry on contract research facilities will increase in the future (see para. 33). It would be expected, therefore, that the Canadian Government would, in the interest of general economic growth, take steps to ensure the continuing viability and operational effectiveness of existing contract research institutes in this country.

53. There are many demands on the Government's available research funds, and the Federal Government faces difficult problems in the equitable allocation of these funds to meet Canada's social, cultural, and economic needs. Government representatives and advisory bodies have, particularly in recent years, emphasised the need to increase expenditures in the applied research and development area with the purpose of increasing the economic return to Canada of the public research dollar. This applied area of research activity is precisely the area in which the Foundation operates. Despite the lack of a yardstick for measuring the overall contribution of R&D to economic growth there is limited but factual evidence (see para. 24) that ORF's activities do play an important part in industrial growth. Furthermore, the fact that the economic potential of each industrial research project at ORF is subject to close scrutiny by the individual sponsor ensures that ORF's efforts are channelled into economically worthwhile areas. It is true that much of ORF's work, from the academic scientists' viewpoint, is "scientifically mundane" and cannot claim to be always in the "scientifically fashionable" category. In view of present needs to bolster the amount of industrially useful R&D a most appropriate concern of the Federal Government at this time would be to ensure that the operations of the Foundation are maintained at an optimum level.

Special Committee

54. In the list of priorities established by various Federal science grant-allocating agencies there seems little reason for the Foundation's low priority for Federal funds. The Foundation's function, objectives, and performance compare very favourably to those of many institutions presently receiving Government grants, and they fall well within the areas stated by the Government as deserving support. The Department of Industry has already undertaken to sponsor industrial research institutes at certain Canadian universities, with the objective of stimulating the undertaking of contract R&D by university staff members. At the same time the National Research Council administers the distribution of very large sums for research at universities, and other sums to industry to aid industrial research. Other Government Departments and Agencies are responsible for maintaining an adequate level of effort in other research areas. Yet among these several Government Departments and Agencies not one is charged with responsibility for ensuring the continued well-being of existing contract research institutes, despite the contribution such institutes are making to industry and despite the emphasis on applied R&D today.
55. In the United States, government support of industrial R&D is increasing both in total amount and in relation to industry's expenditures. At independent non-profit contract research institutes, the U.S. Government in 1957 spent \$1.74 for every dollar spent by industry, 30% of which was devoted to basic research studies. By 1964, U.S. Government support had increased to \$3.70 per industrial dollar. The two largest and most widely known industrially of these institutes, Batelle Memorial Institute (income over \$90 million) and Stanford Research Institute (income about \$60 million), received \$3.00 and \$4.00 respectively from Federal Government sources for every dollar received from industry.
56. At the Ontario Research Foundation comparative statistics show a total income from all Federal sources of only \$0.22 per dollar of Canadian industrial income. This includes the income for the NRC-sponsored Technical Information Service which itself amounts to \$0.05 per industry dollar.

Even when incomes from all Provincial and Federal Government sources are combined, the ratio is only \$1.43 per dollar from Canadian industry compared to the average \$3.70 provided to similar institutes in the United States.

57. In Canada, the relative responsibilities of the Federal and Provincial Governments for support of industrial research are not clear. This lack of clarity, perhaps, has been mainly responsible for the lack of regular Federal support of all Provincial research institutes. In the case of the Ontario Research Foundation, which is not a Provincial Government institute, Department or Agency, lack of Federal Government support is particularly difficult to understand.

58. Because of the nature of the services provided by contract research institutes, the demand for these services is primarily regional. It is in recognition of this that the Ontario Government is now providing ORF with an annual grant as explained in para. 47. This grant, in view of the ORF's independent status and Canada-wide activities, is a very fair contribution toward the maintenance of ORF's basic facility. The Foundation is entirely content with this support and the close relationship that exists between the Ontario Government and itself. However, the provision of this Provincial grant to ORF should not in any sense affect the Federal Government's overall policies or responsibilities in the industrial research area. Ontario is Canada's most heavily industrialised Province, and it is most certainly in the interest of the Federal Government that industry within the Province be served with adequate contract research facilities.

59. At this time, as in the past, ORF is limited in the services it can provide for industry. The Ontario Government grant ensures the future viability of ORF's operations. However, this operation can and should be made more effective than it is at present. This can be achieved by increasing ORF's capacity to serve a wider range of industry with a wider range of services. To do so requires that ORF must expand its skills and its facilities, particularly in the new technologies of growing industrial significances. Only by much closer contact with, and financial support from the Federal Government can this be realised. By this mean, the Foundation's effectiveness and its contribution to the economy of Canada would be greatly enhanced.

APPENDIX

- 1) - Copy of Foundation Act, 1944
- 2) - List of Board Members and Affiliations
- 3) - Fig. 1 Chart of ORF's Sources of Income 1930 - 1968
- 4) - Fig. 2 Chart Showing Increasing Cost of R&D
- 5) - Fig. 3 Charts Showing Endowment Income Facts
- 6) - Fig. 4 Block Diagram of Organisational Structure
- 7) - Officials Representing the Ontario Research Foundation

Research Foundation Act

1944

No. 47

1944

BILL

An Act respecting the Ontario Research Foundation.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

Interpre-
tation,—

1. In this Act,—

"Founda-
tion",

(a) "Foundation" shall mean Ontario Research Founda-
tion;

"Board";

(b) "Board" shall mean Board of Governors of the
Foundation; and

"Executive
Committee".

(c) "Executive Committee" shall mean Executive Com-
mittee of the Board.

Foundation
to be body
corporate.

2. The Ontario Research Foundation shall continue to be
a body corporate.

Objects of
Foundation.

3. The objects of the Foundation shall be the carrying on
of Research, studies and investigations, particularly those
having for their objects,—

- (a) the conservation, development and utilization of the
natural resources of the Province;
- (b) the development and utilization of the by-products
of any processes involving the treating or using of
the mineral, timber or other resources of the Prov-
ince;
- (c) the development and improvement of methods in the
agricultural industry and the betterment, welfare
and progress of farm life;
- (d) the mitigation and abolition of disease in animal or
vegetable life and the control and destruction of
insect or parasitic pests; and
- (e) the improvement and development of industrial
materials, products and techniques.

4.—(1) The affairs of the Foundation shall be managed and
its powers may be exercised by a Board of Governors consisting
of not more than twenty-five members who shall be appointed
by the Lieutenant-Governor in Council and the members of
the Board shall be the members of the Foundation.

Management
of affairs
by Board of
Governors.

(2) A member of the Board may resign at any time.

Resigna-
tion.

5.—(1) The Board at its first meeting after the coming into
force of this Act and at each annual meeting thereafter shall
elect from among its members a chairman and two vice-
chairmen who shall hold office until the next annual meeting
and until their successors are duly elected and who shall be
eligible for re-election.

Chairman.

Special Committee

(2) Any vacancy occurring in any of such offices during ^{Vacancies.} the term of office may be filled by the Board from among its members for the remainder of the unexpired term.

(3) Until the first meeting of the Board held after the coming into force of this Act, the persons presently holding the offices of chairman and vice-chairman of the Foundation shall continue in office and shall administer the affairs of the Foundation. ^{Present chairman and vice-chairman.}

(4) The first meeting of the Board after the coming into force of this Act shall be held at such place and time as may be determined by the Lieutenant-Governor in Council. ^{First meeting.}

6.—(1) There shall be an Executive Committee of the Board consisting of the chairman and vice-chairmen and two other members who shall be elected by the Board from among its members at its first meeting held after the coming into force of this Act and at each annual meeting thereafter and who shall hold office until the next annual meeting and until their successors are duly elected and who shall be eligible for re-election. ^{Executive Committee.}

(2) The Board may delegate all or any of its powers to the Executive Committee and may revoke or amend any such delegation. ^{Delegation of powers.}

7. Meetings of the Board and of the Executive Committee may be held at such places and times as may be determined in accordance with the by-laws of the Foundation, provided that the annual meeting of the Board shall be held not later than the 1st day of May in each year. ^{Place of meetings.}

^{Conduct and administration.} 8. The Board may make by-laws not contrary to the provisions of this Act to regulate the conduct and administration of the affairs of the Foundation in all things and particularly, without limiting the foregoing general power,—

(a) to regulate the calling of and the procedure at meetings of the Board and of the Executive Committee; to regulate the time and place for the holding of such meetings respectively; and to fix the respective quorum for the Board and for the Executive Committee;

(b) to regulate the appointment, functions, powers, duties, remuneration and removal of officers, servants and agents of the Foundation; and

(c) to establish and regulate the appointment, functions, powers, duties, meetings, quorum and removal of, such technical or advisory committees as the Board may deem advisable.

^{Chairman, vice-chairmen, Board, Executive Committee.} 9. The chairman, vice-chairmen and members of the Board and of the Executive Committee shall not be paid any remuneration but, if the by-laws of the Foundation so provide, may be paid any reasonable expenses incurred by them in the performance of their duties and section 93 of *The Companies Act* shall apply *mutatis mutandis* to the Foundation and to the members of the Board and of the Executive Committee in the same manner and to the same effect as though the Foundation were a company incorporated under Part I of that Act and the members of the Board and of the Executive Committee were directors thereof. ^{Rev. Stat., c. 251.}

^{Property and assets of present Foundation.} 10. All property and assets, real and personal, rights and privileges owned, held, possessed or enjoyed by the Foundation immediately prior to the time of the coming into force of this Act shall continue to be vested in the Foundation for the same estate, title or interest.

Powers of
Foundation.

11. The Foundation may,—

- (a) purchase, lease or otherwise acquire and hold any real property or any estate or interest therein deemed necessary for the purposes of the Foundation;
- (b) take by gift, donation, devise or bequest and hold any real or personal property or any estate or interest therein;
- (c) with the prior approval of the Lieutenant-Governor in Council and without the consent of the owner,

47

enter upon, take, use and expropriate any real property or any estate or interest therein deemed necessary for its purposes, and the Foundation shall, in the exercise of the powers hereby conferred, proceed in like manner to that provided by *The Public Works Act* where the Minister of Public Works takes land or property for the use of Ontario, and all the provisions of that Act with respect to entering on land or property, the depositing of a plan, the vesting of title and the determination and payment of compensation shall apply *mutatis mutandis* to the Foundation;

Rev. Stat.,
c. 54.

- (d) construct, maintain and alter any buildings and works deemed necessary or convenient for the purposes of the Foundation; and
- (e) when no longer required for the purposes of the Foundation, sell, lease or otherwise dispose of any real property or any estate or interest therein.

12. The Foundation may carry on research, investigations, studies and operations for other persons upon such terms and conditions as the Executive Committee may determine, subject to any direction of the Board.

Research,
investiga-
tions, etc.

13. The Foundation may purchase or otherwise acquire any invention or discovery or any right therein and may apply for, purchase or otherwise acquire any letters patent of invention or similar protection of the Dominion of Canada or elsewhere or any license or other right, title or interest in or under any patent or similar protection and may hold, use, exercise, develop, license, assign or otherwise dispose of or turn such inventions, discovery, letters patent or protection to account.

Inventions
and
discoveries.

14. The Foundation may pay gratuities, bonuses and allowances to retired or superannuated officers or servants of the Foundation either out of the general funds of the Foundation or out of any special funds set aside for that purpose and may make payments toward insurance, pension, retirement, sickness and other funds or plans calculated to benefit the officers and employees of the Foundation or their dependants or connections, but no payment shall be made to or for the benefit of the chairman, vice-chairmen or members of the Board or of the Executive Committee.

Gratuities.

15. The real and personal property, business and income of the Foundation shall be exempt from all assessment and taxation made, imposed or levied by or under the authority of any Act of this Legislature.

Exemption
from
taxation.

Property of
Foundation
not to be
expropriated.

16. No real property of the Foundation and no estate or interest therein shall be liable to be entered upon, used, taken or expropriated by any municipal or other corporation or person possessing the right of taking land compulsorily and no power to enter upon, take or expropriate land hereafter conferred shall extend to the real property of the Foundation or to any estate or interest therein unless in the Act conferring the power it is made in express terms to apply thereto.

Statutes of
limitations.

17. All real property of the Foundation shall, with respect to the application of any statute of limitations, be deemed to have been and to be real property vested in the Crown for the public uses of Ontario.

Special Committee

- Funds.** **18.** The funds of the Foundation may be invested as the Executive Committee may determine subject to any direction of the Board.
- Auditors.** **19.** The Board at each annual meeting shall appoint one or more auditors who shall hold office until the next annual meeting and until their successors are duly appointed and the auditor or auditors shall yearly examine the accounts of the Foundation and shall report thereon to the Board.
- Annual report.** **20.** The Board shall annually report to the Lieutenant-Governor in Council on the affairs of the Foundation.
- Powers of Foundation.** **21.** The Foundation shall have power to do all such things as are incidental or conducive to the attainment of its objects.
- Rev. Stat., c. 91, 1939, c. 47, s. 81, repealed.** **22.** *The Research Foundation Act* and section 31 of *The Statute Law Amendment Act, 1939*, are repealed.
- Commencement of Act.** **23.** This Act shall come into force on a day to be named by the Lieutenant-Governor by his Proclamation.
- Short title.** **24.** This Act may be cited as *The Research Foundation Act, 1944*.

No. 67

1955

BILL

An Act to amend *The Research Foundation Act, 1944*

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

- 1.** *The Research Foundation Act, 1944* is amended by adding 1944, c. 53, thereto the following section: amended
- 13a. The Foundation may establish and administer Scholarships scholarships to assist in the training of research and scientific workers.
- 2.** Section 20 of *The Research Foundation Act, 1944* is 1944, c. 53, s. 20, repealed and the following substituted therefor: re-enacted
- 20.—(1) The Foundation shall, after the close of each Annual fiscal year, file with the Provincial Secretary an annual report which shall include a financial statement, a description of the work of the Foundation during the previous year and such other information as the Lieutenant-Governor in Council may require. report
- (2) The Provincial Secretary shall submit the report to Idem the Lieutenant-Governor in Council and shall then lay the report before the Assembly, if it is in session, or if not, at the next ensuing session.
- 3.** This Act comes into force on the day it receives Royal Assent. Commence-ment
- 4.** This Act may be cited as *The Research Foundation Amendment Act, 1955*. Short title

BILL 29

1960-61

An Act to amend
The Research Foundation Act, 1944

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. Section 20 of *The Research Foundation Act, 1944*, as re-^{1944, c. 53,} enacted by section 2 of *The Research Foundation Amendment*²⁰ (1955, c. 78), *Act, 1955*, is repealed and the following substituted therefor:²¹
^{re-enacted}

20—(1) The Foundation shall, after the close of each ^{Annual} fiscal year, file with the member of the Executive ^{report} Council who is responsible for the administration of this Act an annual report which shall include a financial statement, a description of the work of the Foundation during the previous year and such other information as the Lieutenant Governor in Council may require.

(2) The member of the Executive Council who is ^{Table} responsible for the administration of this Act shall submit the report to the Lieutenant Governor in Council and shall then lay the report before the Assembly if it is in session or, if not, at the next ensuing session.

2. This Act comes into force on the day it receives Royal ^{Commence-} Assent. ^{ment}

3. This Act may be cited as *The Research Foundation* ^{Short title} *Amendment Act, 1960-61*.

BILL 60

1962-63

An Act to amend
The Research Foundation Act, 1944

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

1. Section 4 of *The Research Foundation Act, 1944* is ^{1944, c. 53,} amended by adding thereto the following subsections: ^{s. 4,} ^{amended}

(3) A member of the Board when this Act comes into ^{Present} force who subsequently resigns may be re-appointed ^{members, re-} ^{appointment} for a term of one, two, three, four or five years.

(4) A member of the Board who is appointed for the ^{Future} first time after this Act comes into force shall hold ^{members,} ^{term of} office for a term of five years. ^{office}

2. This Act comes into force on the day it receives Royal ^{Commence-} Assent. ^{ment}

3. This Act may be cited as *The Research Foundation* ^{Short title} *Amendment Act, 1962-63*.

O N T A R I O R E S E A R C H F O U N D A T I O N

BOARD OF GOVERNORS

| | |
|------------------|--|
| E. H. Ainlay | Senior Vice-President, Finance National Trust Company Limited |
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| K. F. Tupper | Vice-President, Administration National Research Council |
| H. M. Turner | Chairman of the Board Mutual Life Assurance Company of Canada |

FIG. 1
ONTARIO RESEARCH FOUNDATION
TRENDS AND SOURCES OF INCOME

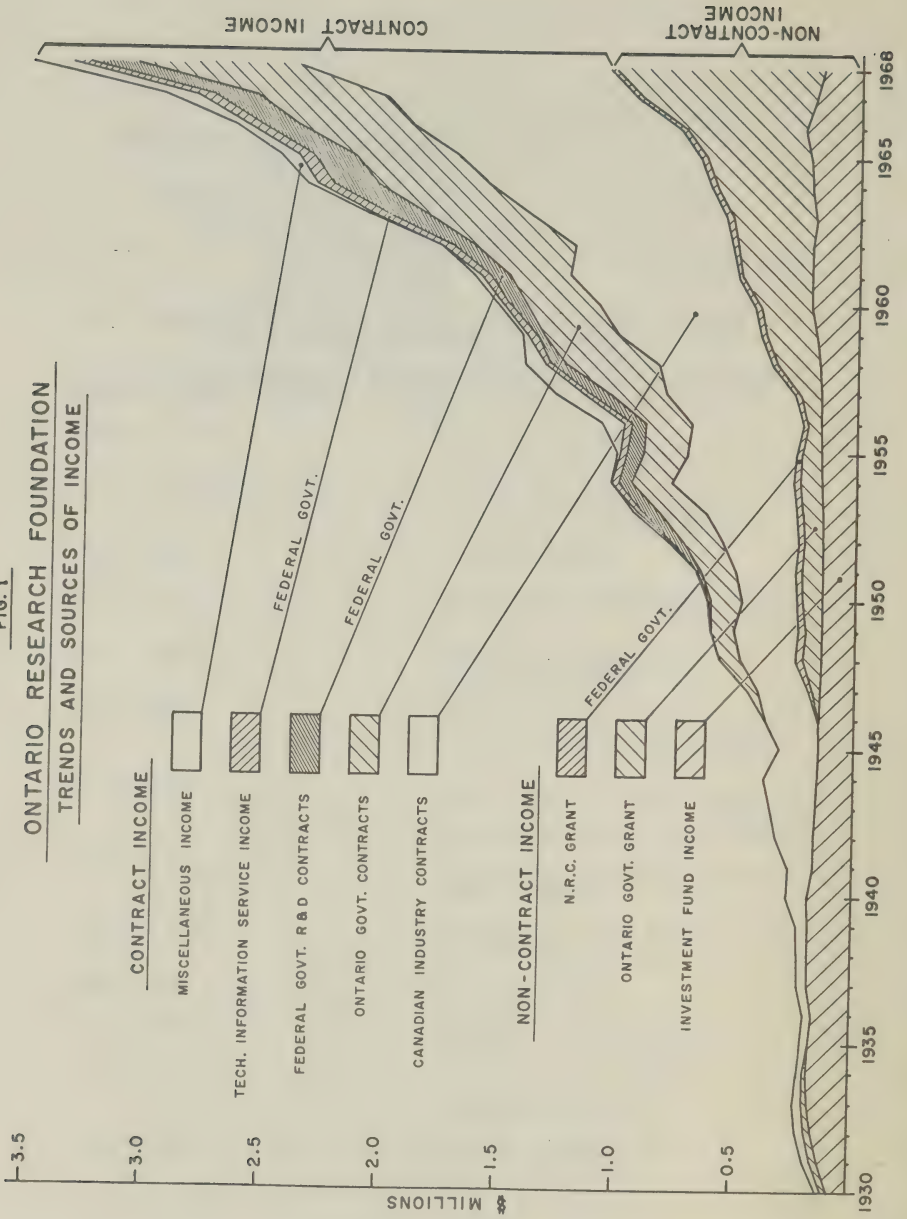


FIG. 2

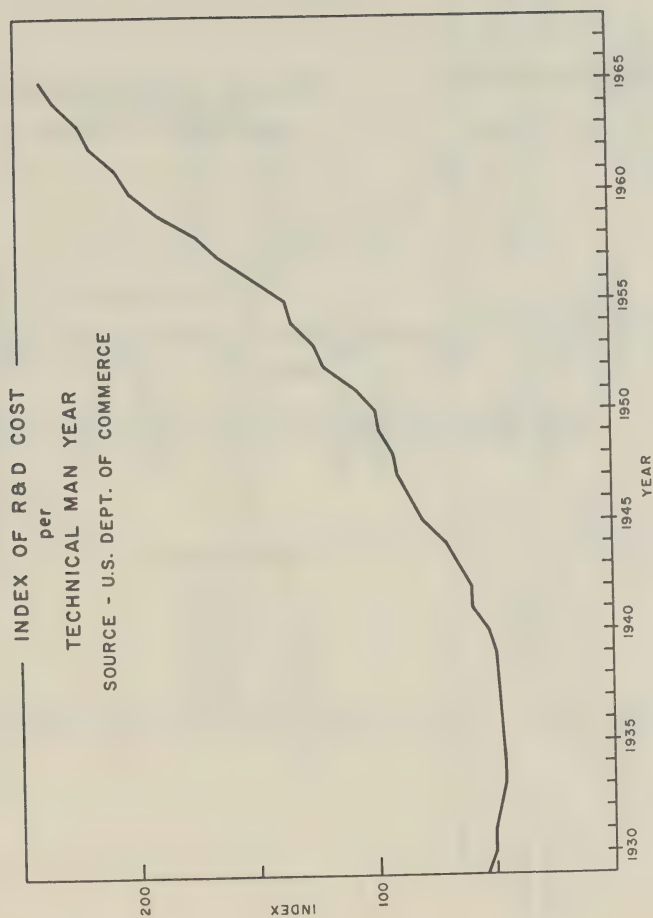


FIG. 3

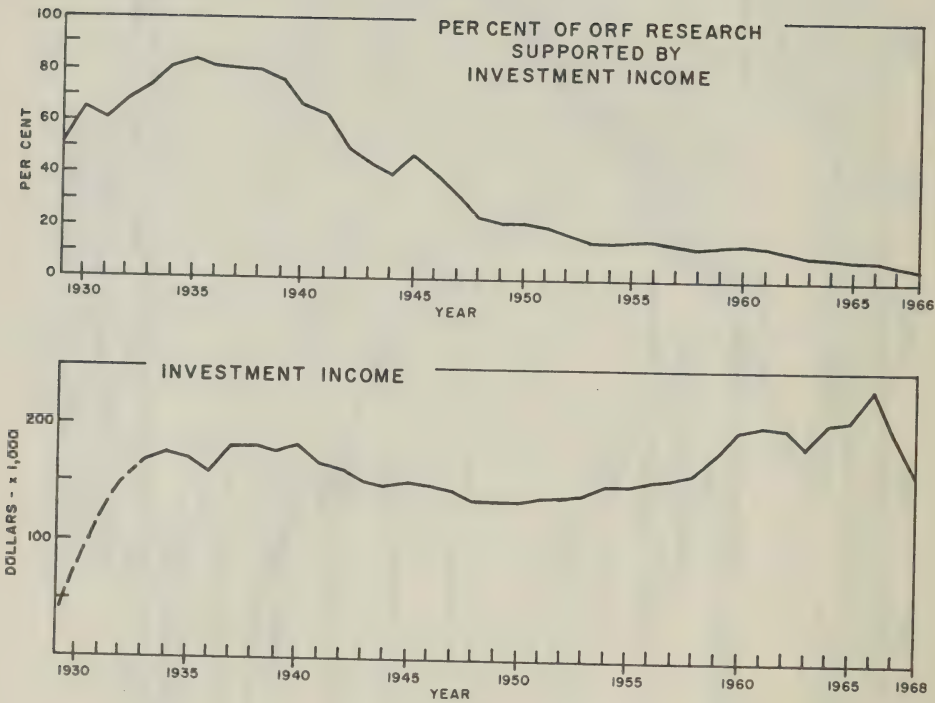
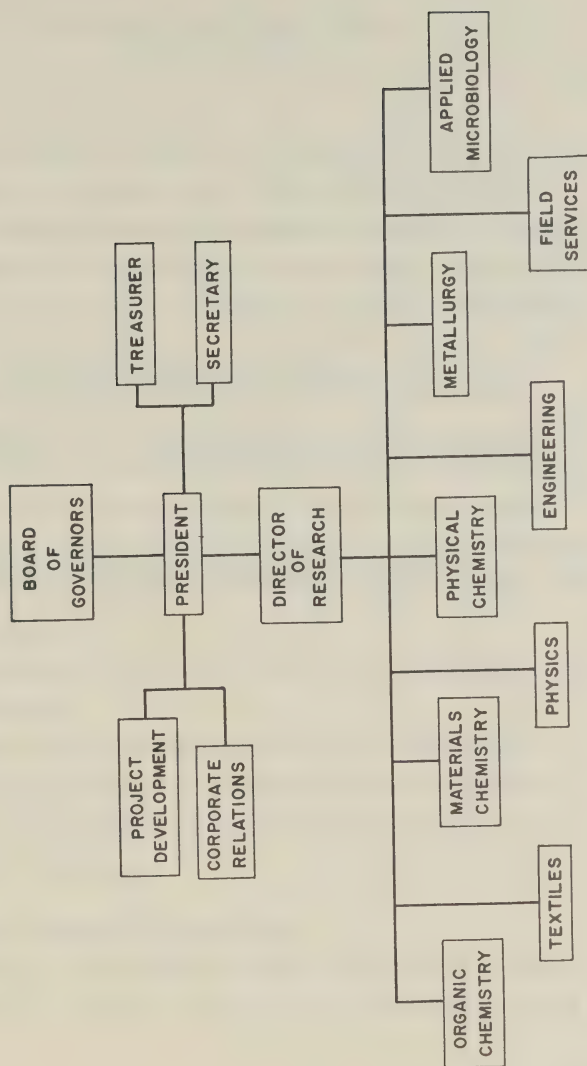


FIG. 4
ONTARIO RESEARCH FOUNDATION
ORGANISATIONAL STRUCTURE



APPENDIX 97

BRIEF SUBMITTED TO THE
SENATE SPECIAL COMMITTEE ON SCIENCE POLICY
BY
BRITISH COLUMBIA RESEARCH COUNCIL

Brief by British Columbia Research

to the

Special Committee on Science Policy
The Senate of Canada

Introduction

Servan-Schreiber in his book, "The American Challenge" (Hamish Hamilton Ltd., London, 1968), describes the (lack of) science policy of the European countries, particularly those within the European Economic Community. The Canadian picture resembles that of the EEC, except that foreign (mainly U.S.) industrial involvement, ownership and control is more advanced in Canada than in the EEC. Some of the points from the book which apply to the Canadian research and development situation are:

1. Lack of communication between universities, industry and government.
2. Lack of planning at the national, provincial and community level; failure to establish clearly defined industrial objectives in R and D.
3. Inadequate R and D expenditure by Government relative to those of the U.S. and the U.K.
4. The persistence of an attitude of sanctity and exclusiveness by the academic people.
5. An immature attitude towards innovation (the most critical and difficult stage in obtaining an industrial pay-off from science).
6. Lack of managerial capacity to embrace R and D, innovation and commercial exploitation.

Some Comments on a National Science Program

1. National R and D objectives should be defined and then "peacetime mobilization" of the university, government and industrial forces set up to

carry the program through.

2. The responsibility for the top level organization and planning of R and D policy falls to the federal government; executing the R and D, to industry and independent laboratories.

3. The federal government should provide the financing for the R and D, with most of the work done by industry and independent organizations.

4. Objectives must be pursued urgently, not only R and D but through industrial innovation. Without the latter, nothing happens except a big bill is run up. Canadian companies are not renowned for taking flyers on new processes or products; they would like the marketing financed from outside as well as the R and D.

5. Both the applied and to a large extent (but not completely) the basic research should be problem-oriented and intended to provide real financial returns to the country. Avoid the concept that most pay-off comes as spin-off from airy-fairy research. It hasn't been paying off very handsomely for us up to now which is part of the reason for the present self-appraisal.

6. R and D financed by the federal government and done by private industry should remain Canadian-owned.

7. The R and D will have to be contracted to medium and large firms. A problem is that relatively few Canadian firms have the required R and D facilities, experience or management capability. Provincial research institutes can be a help, but it is very desirable to have a number of bidders for an R and D contract.

8. Qualified manpower will be a problem, and the acquisition of good men is more important for success than anything else. Retrieval

of experienced Canadians from U.S. industry may be a means of capitalizing on our past "brain drain". (We are beginning to exploit this technique successfully at BC Research.)

9. Expenditure for R and D will have to be increased and eventually be in line with that of U.S. on a per capita basis. For many years however, the limitation will be man power and facilities, not money, that is, if money is not wasted. The important principle in avoiding waste of money is accountability. Men must be expected to produce results in a reasonable time if support is to be continued.

10. Dispense with tenure and the seniority rule. If this is not done, there will never be enough money.

11. Emphasize the contract in preference to the grant wherever possible, including the funding of university research.

12. What are to be the R and D objectives? (those of BC Research marked with asterices; order not significant):

- a) Uses of energy sources (other than atomic)
- b) Atomic energy
- c) Northern research
- d) Electronics
- e) Telecommunications
- f) Transportation; movement of goods (*)
- g) Marine; under water; oceanography (*)
- h) Computers; hardware or software
- i) Chemicals
- j) Pollution; water; air; soil; noise (*)
- k) Mechanical equipment (*)
- l) Instrumentation for sensing, measurement and process control (*)

- m) Space
- n) Urban research (BC Research considering)
- o) Exploration; mining; metallurgy (*)
- p) Forestry and forest products (*)
- q) Fisheries (*)
- r) Agriculture
- s) Building research
- t) Developing-country research (*)

Position of BC Research

1. I am not making any special pitch for independent research institutes. They should be looked upon as potential bidders for R and D contracts, but should be assessed objectively on their individual worthiness. On the other hand, to overlook their usefulness would be to disregard a resource of which the country is very short.
2. BC Research would be prepared and most anxious to tie in with an integrated plan for R and D in Canada. But we would not look forward to money being made available as an R and D slush fund. We have learned over the years how to earn our way in the industrial R and D field (75% self-supporting) and have slowly but steadily been building up our long term contracts in our fields of expertise and increasing our royalty income from patents. This has been done by using both our research experience and our innovative wits while receiving less subsidization than any of the other five provincial research institutes in Canada. To have R and D slush funds set up would be the worst thing that could happen to us psychologically - whether we were on the receiving end or not.

3. I have seen the draft of the brief submitted by the Research Council of Alberta and concur with the points presented.

4. I shall be available to members of the Senate Committee for consultation on this important subject, should they wish.

P.C. Trussell
Director
B.C. Research

April 2, 1969

PCT/mjp

THE QUEEN'S PRINTER
OTTAWA, 1969



First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 51

TUESDAY, JUNE 3, 1969

WITNESSES:

Human Resources Research Council of Alberta: Dr. Gordon McIntosh, Co-Chairman, Research and Development Studies, Dr. Harold J. Dyck, Chairman, Planning and Policy Studies; Canadian Teachers' Federation: Mr. Norman H. Goble, Deputy Secretary-Treasurer, Miss Geraldine Channon, Projects and Information Officer.

APPENDICES

98—Brief submitted by the Human Resources Research Council of Alberta

99—Brief submitted by The Canadian Teachers' Federation

100—Brief submitted by The Canadian Council for Research in Education

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries,

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the board principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy in Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place.

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—

Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

“With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 3, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.15 p.m.

Present: The Honourable Senators Cameron (*Acting Chairman*), Belisle, Bourget, Carter, Grosart, Haig, Kinnear, McGrand and Yuzyk—9

The following witnesses were heard:

HUMAN RESOURCES RESEARCH COUNCIL OF ALBERTA

Dr. Gordon McIntosh, Co-Chairman
Research and Development Studies
Dr. Harold J. Dyck, Chairman,
Planning and Policy Studies

CANADIAN TEACHERS' FEDERATION

Mr. Norman M. Goble, Deputy Secretary-Treasurer
Miss Geraldine Channon, Projects and Information Officer.

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

No. 98—Brief submitted by the Human Resources Research Council of Alberta

No. 99—Brief submitted by the Canadian Teacher's Federation

No. 100—Brief submitted by The Canadian Council for Research in Education.

At 5.35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie
Clerk of the Committee

CURRICULUM VITAE

Channon, Geraldine—Born in Ottawa, Ontario. Education: Glebe Collegiate Institute, Carleton University—awarded 4-year honours Bachelor of Arts degree (first-class honours in English literature). Received, among other awards, University Medal in Arts and Governor-General's Medal for highest standing in graduating class. University of Toronto—successfully completed course work for Master's degree in English. Subsequent work—Economics and Sociology courses. Also is an Associate of the Royal Conservatory of Music of Toronto (piano). Single. Appointed to CTF staff as Research Assistant, September 1, 1957. Promoted to Projects and Information Officer, July 1, 1966. As part of her duties Miss Channon has participated in a number of research studies conducted by CTF and has acted as CTF representative at research meetings and conferences in Canada, United States and abroad. She has also been responsible for coordinating CTF's Teacher Education Project.

Dyck, Harold Jacob. Born January 28, 1932, Redfield, Saskatchewan, Canada. Married Eleanor Vogt, August 21, 1954. Children: Raymond, age 13; Debbie, age 11; Mary, age 8; Julia, age 6; Harold Jr., age 4. POSITIONS HELD: 1. 1968 (Summer Quarter), Visiting Assistant Professor, Division of Planning, Policy and Administration, Department of Education, The University of California, Berkeley, California. 2. 1967-, Assistant Professor. Centre for the Study of Administration in Education, The University of British Columbia, Vancouver, B.C., Canada. 3. 1965-, Director, Politics of Education Research Project, University of California, Berkeley, California and United States Office of Education, Department of Health, Education and Welfare, Washington, D.C. 4. 1965-1967, Assistant Research Political Scientist, Institute of Governmental Studies, University of California, Berkeley, California. 5. 1952-1967, Lecturer, Division of Educational Administration, School of Education, University of California, Berkeley, California. 6. 1960-1963, Research Fellow, School of Education, Stanford University, Stanford, California. 7. 1957-1959, Principal, private secondary school, Coaldale, Alberta. 8. 1955-1957, Teacher, private secondary school, Yarrow, B.C. EDUCATION: 1. 1959-1962, Stanford University, Stanford, California: Major field: Philosophy of Education; minor field: Philosophy of Language; Ph.D. dissertation, "The Concept of Education: A Philosophical Analysis". Major advisors: Dr. Lawrence G. Thomas, Professor of Education; Dr. John Goheen, Head and Professor, Department of Philosophy; Dr. H. Thomas James, Dean and Professor, School of Education; Dr. Frederick MacDonald, Professor of Psychology and Education. 2. 1954-1955, The University of British Columbia, Vancouver, B.C.: teacher education courses leading to a secondary teaching credential. 3. 1950-1953, The University of British Columbia, Vancouver, B.C.: Majors: History and English; minor fields: Philosophy and Psychology; B.A., 1953. 4. 1946-1950, Secondary schools in Yarrow and Chilliwack, B.C.; graduated from Chilliwack Senior High School in 1950 (junior matriculation). ACADEMIC AWARDS, DISTINCTIONS AND RESEARCH GRANTS: Tuition Scholarships for each quarter, 1960 and 1961, Stanford University Research Fellowship, 1960, 1961, 1962, Stanford Graduate Studies Fellowship, 1961-1962, National Science Foundation Research Grant, 1962-1963 (\$1,600.00), University of California Research Grant, 1963-1964

(\$1,800.00), United States Office of Education Grant, 1965-1967 (\$125,000.00), United States Office of Education Grant, 1968 (\$6,200.00), Canadian Department of Labour, 1968-1969 (\$4,760.00), University of British Columbia, Faculty Research Committee, 1968-1969 (\$1,200.00), Koerner Foundation (with others), 1968-1969 (\$1,000.00). SCIENTIFIC AND PROFESSIONAL ASSOCIATION MEMBERSHIPS: American Political Science Association, Phi Delta Kappa (President, Delta Chapter, Stanford University, 1961-1962), American Education Research Association, Canadian Education Association, Canadian Association of University Teachers, Canadian Educational Researchers Association, Philosophy of Education Association, American Association of School Administrators. UNIVERSITY TEACHING EXPERIENCE: Stanford University, Stanford (School of Education), 1961-1962. Graduate courses: School Law, School Finance (jointly with Dean H. Thomas James). The University of California, Berkeley, California (Department of Education), 1962-1967 and Summer, 1968. Graduate courses: Politics of Education, Social Research Methods, Administrative Theory, The Administration of Education Organizations. The University of British Columbia, Vancouver, B.C. (Faculty of Education) 1967. Senior courses: Introduction to Educational Administration Graduate courses: Politics of Education, Doctoral Seminar. SUPERVISION OF GRADUATE STUDENT RESEARCH: (Note: The studies listed below include only those for which I have had the major supervisory responsibility.) 1968-, Dunn, Lester, *The Determinants of Roll Call Voting on Education in the California State Legislature*, 1967-1968, (Ph.D. Dissertation, University of California at Berkeley, in progress). Hodgkinson, Christopher, *Values and Perceptions in Organizations: A Study of Personal Values and Social Interaction Perceptions in Education Organizations*, (doctoral dissertation, University of British Columbia, in progress). Ross, William, *The Politics of Teacher Negotiations: A Study of the Development of the Winton Act*, (Ed.D. thesis, University of California at Berkeley, in progress). 1967-1968, Brown, Daniel J., *The Productivity of University Educators*, (M.A. thesis, University of British Columbia, 1968). Inglis, Sydney, *Decision-making by the California State Board of Education: A Case Study of the Implementation of the Fisher Act*, (Ed.D. thesis, University of California at Berkeley, 1968). Livingstone, James A., *University and Fragmentation Among Education Groups: An Interorganizational Analysis*, (Ed.D. thesis, University of California at Berkeley, 1968). 1966-1967, Galbraith, Francis, *The Power of the State Superintendent of Public Instruction*, (Ed.D. thesis, University of California at Berkeley 1967). Lufkin, Allan, *A History of the California State Curriculum Commission, 1946-1966*, (Ed.D. thesis, University of California at Berkeley, 1967). Milstein, M., *The Impact of Federal Education Programs on the State Administration of Education*, (Ph.D. dissertation, University of California at Berkeley, 1967). 1965-1966, Cameron, James, *The Effects of Invention Characteristics on the Process of Innovation in School Organizations*, (Ed.D. thesis, University of California at Berkeley, 1966). Sawatsky, Leonard, *A Cultural Geography of the Mennonites in Mexico*, (Ph.D. dissertation, University of California at Berkeley, 1966). Supervised for the Department of Geography. Zollinger, Alice, *The Politics of the Fisher Acts An Analysis of Reforming Teacher Certification*, (M.A. thesis, University of California at Berkeley, 1966). 1964-1965, Lowery, Lee, *Search Processes in the Legislative System*, (Ed.D. thesis, University of California at Berkeley, 1965). 1963-1964, Jensen, Jane, *Political Influence in the Education Committee of the California State Legislature*. (Ed.D. thesis, University of California

at Berkeley, 1964). PUBLIC AND PROFESSIONAL SERVICE: 1968-, Consultant, Urban Education Project, United States Office of Education, Department of Health, Education and Welfare, Director: Dr. James Guthrie, University of California at Berkeley. Consultant, Teacher Shortage Research Project: Director: Dr. Walter J. Hartrick, University of British Columbia, Vancouver. Appointed Member, Canada Welfare Council's B.C. Committee on Public Housing; Chairman: Mr. Arthur Block, Vancouver, B.C. Elected Member-at-Large, Executive Council of the U.B.C. Faculty Association, President: Dr. William Weber. 1967-1968, Assistant Director, Simulated Workshops for School Administrators in Terrace, Chilliwack, and Kamloops; Director: Dr. Walter J. Hartrick, University of British Columbia, Vancouver, B.C. Consultant, Administrator Selection Project, Kamloops; Director: Dr. Walter J. Hartrick, U.B.C. Editorial Consultant, University of California Press, Berkeley, California. 1966-1967, Consultant, Political Action Committee, California Teachers Association; Chairman: Mr. Jack Rees, Burlingame, California. Adviser, Citizens' Committee on Public Education, San Francisco. Adviser, Education Extension, University of California at Berkeley (Politics of Education Conference). 1963-1965, Consultant, Vocational Education Research Project, United States Office of Education, Department of Health, Education and Welfare; Director: Dr. J. C. Lester Swanson, University of California at Berkeley. Assistant Director, Simulated Workshops for School Administrators, College of Idaho, Caldwell, Idaho, Spring, 1963 and Summer, 1964; Director: Dr. Frank Farnier, Washington, D.C. Program Director, U.S. Department of State's A.I.D. Training Program for Educational Leaders from Asian Nations, University of California, Berkeley, Summer, 1963. Member, Board of Education for Berkwood School, Berkeley, California (Berkwood School is a private experimental institution). 1961-1963, Consultant, School Community Relations Research Project, Stanford University; Director: Dr. Richard Carter, currently at the University of Wisconsin, Madison, Wisconsin. Consultant to a number of different school districts in California on problems in school finance, administrator selection, school-community relations and administrative organization. UNIVERSITY COMMITTEE SERVICE: 1968-, Elected member, Graduate Working Committee, Faculty of Education, U.B.C.; Chairman: Dr. Glen Chronister. Appointed member, The Graduate Board, Faculty of Education, U.B.C.; Chairman: Dr. Glen Chronister. Chairman, Doctoral Committee for Mr. Christopher Hodgkinson, Educational Administration, Faculty of Education, U.B.C. Member, Committee on the Structure and Organization of the Faculty of Education, Commission on the Future of the Faculty of Education. Member, Dean's Committee on Computer Application in the Faculty of Education; Chairman: Dr. Robin Smith, Professor of Education, U.B.C. 1966-1967, Member, Committee on the Development of a Data Bank on California Politics, University of California at Berkeley. 1965-1966, Member, Faculty-Student Liaison Committee, University of California at Berkeley. 1962-1967, Numerous doctoral committees, in addition to those required by studies listed above. PAPERS AND ADDRESSES: 1. "Politics and Education: The Search for New Strategies." A paper read to the School Administrators' Conference, Friday, November 15, 1968, Hotel Vancouver, Vancouver, B.C. 2. "Political Barriers in the Allocation of Resources to Education." An address to Seventh Conference and Workshop of British Columbia Principals, University of British Columbia, July, 1968. 3. "The Role of Party and Profession in Educational Reform." A paper delivered at the annual meeting of the American Educational Research Asso-

ciation, Chicago, February 8, 1968. 4. "The Politics of Education in Mass Society: A Critical Look at California." An address to the Conference on "Critical Issues in Contemporary Education", University of California at Riverside, January 27, 1967. 5. "The Politics of Teacher Negotiations." An address to the Conference on Teacher Negotiations sponsored by Phi Delta Kappa, University of California at Berkeley, July 29, 1967. 6. "The Election and State Politics of Education." An address given to the California Association of Secondary School Administrators, Hayward, California, November 15, 1966. 7. "Schoolmen and Politics in California." An address given to the Fremont School Administrators Association, Fremont, California, January 16, 1967. 8. "Educational Leadership in the Political System." An address given to the Conference on Teacher Education, Clear Lake, California, April 22, 1966. 9. "The Politics of Education as a Field of Research." An address to the annual meeting of the California Association of School Administrators, University of California at Berkeley, January, 1966. 10. "The Political Functions of the Anti-Political Ideology in Education." An address to the annual conference of the California Association of Elementary School Administrators, Sacramento, California, 1965. 11. "The Uses of Simulation in the Development of School Administrators." An address to the annual conference of the National Association of Elementary School Principals, Minneapolis, Minnesota, April 1964. 12. "Teaching as a Cause of Learning and Teaching as a Reason for Learning." A paper delivered at the Far West Philosophy of Education Society, Fresno, California, December, 1963. 13. "The Political Integration of Local School and Multi-Function Governments." A paper delivered at the annual international conference of school superintendents from far western states, Carmel, California, November, 1962. 14. "Institutional Factors in Education Expenditure Decisions." A paper delivered to the Stanford Conference on School Finance, Stanford, California, Spring, 1962. 15. "The Grammar of 'Teaching' and 'Learning'." A paper delivered to the annual meeting of the Far West Philosophy of Education Society, December, 1961. PUBLICATIONS: *The Legislative Politics of Education in California* (Washington, D.C.: Co-operative Research Branch, Office of Education, Department of Health, Education and Welfare, Research Project 3178). Note: This research monograph is currently in preparation—to be available later in 1968. It reports research done over a three-year period (1965-1968) on the politics of education in the California State Legislature during the years 1955-1966. "Political Barriers in the Allocation of Resources to Education." Addresses of the Seventh Conference and Workshop of the British Columbia School Principals (Vancouver: University of British Columbia, to be published later this year). "The legislative Bases of Educational Policy: A Progress Report on Research at the University of California." A report to the U.S. Office of Education, June, 1967. Available in mimeographed form. *The Concept of Education: A Philosophical Analysis* (Ph.D. dissertation, Stanford University). *The Politics of Education in California: Studies in Educational Reform and Policy Negotiation*, (School of Education, University of California, 1966) 142 pages. With H. Thomas James and J. Alan Thomas, *Wealth, Expenditures and Decision-Making for Education* (Washington, D.C.: Cooperative Research Branch, Office of Education, Department of Health, Education and Welfare, 1963), 180 pages. PROJECTS IN PROGRESS: 1. "The Partisanship of Education Interest Groups." A further analysis of data collected for the California study listed above. Part I to be completed December 1, 1968; Part II to be completed February 1, 1969. 2. "An Analysis of Voting Behavior

in California." A further analysis of data collected for the California study listed above. To be completed December 15, 1968, for the Institute of Governmental Studies, University of California at Berkeley. 3. "Labour-Management Relations in Canadian Research Organizations." A project funded by the Canadian Department of Labour. To be completed by June 30, 1969. 4. "Tensions in Education Policy Making in British Columbia: An Analysis of Interorganizational Relations." A project funded by the University of University of British Columbia Committee on Faculty Research. To be completed by April 1, 1969. 5. "A Study of Legislative Involvement in Education." A secondary analysis of data collated for the California study listed above. To be completed Summer, 1969. 6. "The Politics of Education in Mass Society." This project was begun several years ago. The planned result is a monograph which incorporates comparative data on major recent educational reform movements in such countries as Australia (particularly in New South Wales), West Germany (g., the reform of higher education in the state of Hessen), the United States, England, Sweden and Canada. Much of the information has already been collected. There is no date for the completion of this project.

Goble, Norman M. Born in Scotland. EDUCATION: Dumfries Academy, Edinburgh University (awarded the degree of M.A. with Honours in Classics, and the Hardie Prize for critical essays on Latin Literature). Married, with two children. Holds the Scottish General Teacher's Certificate, the Scottish Special Certificate (Classics) and the Ontario High School Specialist Certificate (Classics). In the British Army from 1942 to 1947, saw commissioned service in infantry, as a liaison officer with the Belgian army, and on intelligence and administrative staff. Taught for nine years in Scotland as an assistant and as head of a department, before coming to teach in Canada in 1958. Last teaching position: head of Department of Classics, Ridgemont High School, Ottawa. Has taught Latin, Greek, English, French and History at various levels.

From 1959 to 1964, was Sessional Lecturer in Classics at Carleton University and part-time Lecturer at Ottawa University. Active in teachers' organizations since 1949: In the Scottish Secondary Teachers' Association, served as Convenor of the Edinburgh region, member of the National Council, member of the Committee on Automation, chairman of the Committee on the Objectives and Content of Education, and representative of specialist teachers on the National Executive. In the Ontario Secondary School Teachers' Federation, served as Secretary of the Ottawa District from 1962 to 1964. Member of the Canadian College of Teachers. Appointed to present position, January 1, 1964. CTF representative on Canadian Commission on School Broadcasting and Council for School Broadcasting in the English Language.

McIntosh, Robert Gordon Jr. Born, Saskatoon, Saskatchewan July 16, 1936. Married, 3 children. EDUCATION: Caswell Hill Public School, Saskatoon, Saskatchewan, 1950. Bedford Road Collegiate Institute, Saskatoon, Saskatchewan, 1954. University of Saskatchewan, Saskatoon, Saskatchewan; B.Sc. *With great distinction*, 1958 chemistry and mathematics; M.Sc. 1959 physical chemistry Thesis: "The Gamma-Initiated Radiolysis of Aqueous Chloral and Bromal Hydrate Solutions"; B.Ed. *With great distinction*, 1961; Harvard University; Ed.M. 1964 history of science; secondary school organization and curriculum; Ed.D. 1968 educational administration Thesis: "A Comparative Study of Clinical Training". WORK EXPERIENCE: Research assistant in chemistry,

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ACADEMIC HONORS: Union Carbide Undergraduate Scholarship, 1954-1958. National Research Council Bursary, 1958-1959. Dupont Scholarship for Teachers of Science and Mathematics, 1960-1961. Canada Council Scholarship, 1962-1963. Imperial Oil Graduate Research Fellowship, 1962-1963, 1965-1967. Arthur Lehman Scholarship, Harvard University, 1965-1968. R. G. McIntosh, "Teacher Education and Professional Socialization," unpublished qualifying paper, Harvard Graduate School of Education, 1967. Accepted *with distinction*. PUBLICATIONS: W. E. Harris, W. H. McFadden, and R. G. McIntosh, "Chemical Effects of the (n, α) Activation of Bromine in the Alkyl Bromides: A New Method for Determination of Organic Retention," *Journal of Physical Chemistry*, 63: 1784-1785 (October, 1959). R. G. McIntosh, R. L. Eager, and J. W. T. Spinks, "Mean Lifetime of Free Radical Chains Determined by a Flow Technique," *Science*, 131: 992 (April, 1960). W. H. McFadden, R. G. McIntosh, and W. E. Harris, "Chemical Effects of the (n, α) Activation of Bromine in the Alkyl Bromides: Isomerization in the Bromobutanes," *The Journal of Physical Chemistry*, 64: 1076-1078 (August, 1960). R. G. McIntosh, D. G. Fisher, R. L. Eager, and A. B. Van Cleve, "Factorial Design in the Study of Acid Leaching of Pegmatitic Uranium Ores," *Canadian Journal of Chemical Engineering*, 39: 139-144 (1961). R. G. McIntosh, R. L. Eager, and J. W. T. Spinks, "The Radiation Chemistry of Aqueous Solutions of Chloral Hydrate and of Bromal Hydrate," *Canadian Journal of Chemistry*, 42: 2033-2042 (1964). R. G. McIntosh, "The Saskatchewan Internship Program: An Experiment in Teacher Education," *Arbos*, 1 No. 2 (November, 1964). R. G. McIntosh, R. L. Eager, and J. W. T. Spinks, "Mean Lifetime of Free Radical Chains in Co⁶⁰-Irradiated Chloral Hydrate and Bromal Hydrate Solutions," *Canadian Journal of Chemistry*, 43: 3490-3495 (1965). D. J. Armor, J. B. Giacuinta, R. G. McIntosh, and Diana Russell, "Professors' Attitudes towards the Vietnam War," *Public Opinion Quarterly*, 31 No. 2 (Summer, 1967).

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 3, 1969

The Special Committee on Science Policy met this day at 3 p.m.

Senator Donald Cameron (Vice-Chairman) in the Chair.

The Vice-Chairman: Honourable senators, this afternoon we have from the Human Resources Research Council of Alberta Dr. Harold Dyck and Dr. Gordon McIntosh, to whom I should explain that our procedure has been to have a short statement on the brief and then to open the meeting for questions. First I will ask Dr. McIntosh to make his preliminary statement.

Dr. Gordon McIntosh, Co-Chairman, Research and Development Studies, Human Resources Research Council of Alberta: Mr. Chairman, honourable senators, we are very pleased to be here. First of all I should like to express the regret of Dr. Downey, the Director of the Human Resources Research Council, at being unable to be with you today because of a serious illness in the family. He is very interested in the work of this Special Committee on Science Policy and profoundly regrets his inability to be here. However, we are very pleased to be here in his stead.

Dr. Dyck and I have divided our presentation between us. I will begin by making several preliminary statements about the Human Resources Research Council, covering material that has not been presented in the brief but which may be of interest to you as background material bearing on our organization.

As you may or may not know, we are a very young organization and to that extent we are not able to come before this Special Committee on Science Policy and talk to you of our accomplishments. However, we are old enough—nine months almost to the day—to have worked out a set of aspirations and goals, and it is about these aspirations and goals for our organization that we are here to speak to you. This means, of course, that we

will have at times to be evasive or vague when it comes to concrete matters, but we will try to be as exact and as precise as we can be about where our organization fits in the public policy sphere in the Province of Alberta, and where we think our organization will go over the next few years.

First we should make clear that the Human Resources Research Council of Alberta is a product of or has been created by the government of the Province of Alberta. We are a crown agency. We interpret "crown agency" to mean that we are somewhere between a government and a private organization. We have a board of governors of ten persons appointed by the Lieutenant Governor in Council. These ten members of our board of governors are representative of public life in the Province of Alberta. Two members of our board are cabinet ministers, the Minister of Education and the Provincial Treasurer; there are also a deputy minister, the Deputy Minister of Education; a university president and a university vice-president; and we have leading persons from a number of voluntary organizations in Alberta, such as the Alberta Teachers' Association and the Alberta School Trustees' Association—people who are very interested in the realm of human resources development. Our board of governors, then, establishes the policies for our organization.

At the present time we are entirely dependent on the provincial government for the funds through which we operate. We are very hopeful, however, that these funds from provincial sources will be supplemented by federal and foundation funds, and that we will be able to take on a slightly more diversified kind of financial support.

The Human Resources Research Council has been created, to quote the legislation creating the council, "to do or cause to have done research bearing on the development and conservation of human resources in the

Province of Alberta". Throughout our presentation I hope the concept of human resources development becomes more clear. Dr. Dyck will certainly have a good deal to say about human resources development throughout his presentation as I will in mine.

The Human Resources Research Council has been created to supplement, but not to put aside or to in some ways supplant the research capability in the social sciences assembled already in the province. We plan to work and are already working very closely with the Government agencies and with the three universities in the province. Much of the research which we are conducting will be done through means of commissioning. We will commission scholars through Alberta universities to undertake studies which the council deems to have high priority. Through this means we hope to keep our staff of a rather small character. We do not plan to be a large organization, but rather work as a co-ordinating agency in close relationship to other research agencies in the province, supplementing, co-ordinating, and helping these other agencies as much as we can.

Our general mandate in the area of research on human resources development will be discharged in three ways. I have mentioned one, that of commissioning research to university scholars. We also operate a grants and aid program which will support research initiated by scholars in Alberta.

Finally, we will mount a small but, we hope, significant in-house research development capability. Dr. Dyck and I are both representatives of in-house research capability which the council is establishing.

Many of my remarks today might have indicated that we are primarily an educational research and development agency. We are this, and I suppose it is because we are an educational and development agency that we appear at these hearings at the same time as the Canadian Teachers' Federation and the Canadian Council for Research in Education. Certainly we plan to have a significant involvement in educational research and development; however, we are not only an educational research and development organization. This is very important, because the principles on which we have been founded are very sound, and will be of importance to you.

We are an interdisciplinary social science research group. Dealing with education is one

of our concerns, but we also work in a number of other areas. Dr. Dyck, for example, will be talking to you about urban studies, studies of poverty and studies of manpower planning and development. These are all areas in which the Human Resources Research Council plans to work and is already working. We are an interdisciplinary group, with education being one of our foci of attention. We think it is important to organize in an interdisciplinary fashion because it is in this way that we can perhaps constitute an addition to the social science capability of the province and of Canada in a way that the universities are presently less able to do.

The universities, as you are well aware, are organized by departments, and most research takes the form of studies within a single discipline. We hope that we will be able to mount projects in which the various kinds of social science skills or capabilities in economics, sociology, geography, psychology, and so on, can be brought to bear on single problem areas. In other words, we want a variety of points of view to be brought to bear on these problems. The council is organized in two main areas for the discharge of its program. I will speak very briefly about one of these areas and Dr. Dyck will speak at greater length on the second.

The two main areas of our activities are referred to as research and development studies, and planning and policy studies. Research and development studies is the area of the council's operation in which I am involved, and it places emphasis on development. This part of the council's operation sees itself as having as its responsibility the mounting and elevating of pilot projects before they find embodiment in legislation and in the planning of social agencies. This is an attempt to find out, on a small scale, how best to perform various kinds of tasks associated with human resources development before we move into large-scale ventures requiring large sums of public money for their universal implementation.

The projects we are now mounting in the research and studies are almost exclusively in the area of education. I will mention two or three as examples. We have one project we call the individualized learning project. This is an attempt to develop curriculum and instructional procedures which can make it possible for students to learn in their own way and at their own rate, and to move away

from the kind of instruction which characterizes our schools at the present time. When instruction is held totally in a group, all members of the group move at the group's rate, even though individual members could move faster if given the possibility to do so while others may have to move more slowly, because of their abilities and aptitudes. Therefore, the individualized learning project is a development project. It is a kind of project which is going forward on a field trail and experimentation basis in a number of school systems in the province.

A second type of study which we are moun'ing in the research and development studies area is the rural high schools project. We are trying to find ways and means to enhance educational opportunity in small schools. You are well aware that the levels of achievement are much lower in rural schools where the drop-out rate is higher and the general level of educational opportunity is below that offered in our urban schools. We are trying to find ways and means of developing solutions whereby this can be corrected.

This is a very brief summary of what the research and development studies area of council is involved in. The planning and policy studies area of council will be discussed by Dr. Dyck. Let me just recapitulate very briefly the overall view of the council. It is a public agency. It is often referred to as a quasi non-governmental agency. It is a Crown agency of the Province of Alberta charged with doing research and development on the development of human resources in the province. It has been in existence for nine months only. On the basis of our first nine months' experience this kind of organization fulfills a role in social sciences heretofore unfulfilled in Canada. There have been, of course, recent developments in other countries such as the United Kingdom, with its schools council; the United States, with its regional education laboratories and other developments over the last few years. We feel that we are perhaps the second provincial organization in Canada addressing the kinds of questions I have been talking to you about.

With this brief introduction I will ask Dr. Dyck to talk to you about the planning and policy studies area of the Human Resources Research Council.

Senator Grosart: You said you were the second. Did you mention the first?

Dr. McIntosh: We are in somewhat of a competition with the first. We think we are

different from them in many ways. I would say the first organization in Canada, created for the purpose of educational research and development alone, would be the Ontario Institute for Studies and Education. We are a somewhat more broadly based organization than the Ontario institute, but with similar concerns.

The Vice-Chairman: Thank you, Dr. McIntosh. It might be useful for the committee if we had a word or two about your individual backgrounds. What is your own field specialization?

Dr. McIntosh: I am somewhat of a hybrid and perhaps the only person appearing before the Special Senate Committee on Science Policy who has graduate degrees in both the physical sciences and the social sciences. I have worked for the Atomic Energy of Canada, Limited, the Social Science Organization and the Human Resources Research Council. I hold a doctorate from Harvard University and my main field of interest is that of education.

Dr. Harold Dyck, Chairman, Planning and Policy Studies, Human Resources Research Council of Alberta: Mr. Chairman and honourable senators, I am a Canadian. I took my Ph.D. at Stanford University in analytical philosophy. I found it personally not very satisfying, though very useful in terms of the tools. I was on faculty at the University of California at Berkeley from 1963 to 1967 where I served as research political scientist with the Institute of Governmental Studies and as part-time lecturer in the School of Education in the field of politics and education.

Two years ago I came to the University of British Columbia to work in the centre for the study of administration in education. Now I am with the Human Resources Research Council—as of yesterday, though I have worked along with the council and the consultant for a number of months.

I should like to emphasize two important distinctions between the kind of work that the Resources Research Council is doing at the present time and will do in the future, the kind of work that is conducted in universities as I see them.

First of all, and Dr. McIntosh mentioned this, the Council is making a deliberate attempt to overcome the kind of adminis-

trative and disciplinary partitioning which seems to govern universities and is trying to foster multi and interdisciplinary approaches to various kinds of problems which indeed require interdisciplinary work, for example, the problems pertaining to poverty.

Secondly, in the university in the social sciences, as I see the development of the social sciences, and as I talk to social scientist I find enormous commitment, intense commitment, very deep commitment to the development of social sciences, to the development of theory and to the testing of theory.

In the Human Resources Research Council the commitment is not so much to the development of theory; indeed it is a commitment to the development of policy. It is an interesting question—which I suppose this committee has debated in one way or another—as to whether or not social science develops best in a relatively politically and autonomous environment, or whether it develops best when it is adjoined to social concern and issues which are established by various political mechanisms.

Senator Grosart: What is the difference between those two? They seem to be the same thing?

Dr. Dyck: Between the development of theory and taking the research problems as problems with respect to the verification of theory, as opposed to taking problems of a policy sort, a practical sort, where a theory may not extend to cover that problem, and doing exploratory research work which is directly related to the resolution and the solution of problems, rather than the verification of theory.

The two will indeed overlap in many cases, but I do not think they necessarily overlap because I think the social sciences—at least, some social sciences—are underdeveloped at this point.

I think the commitments and the motives in the two instances are quite distinct, one being concerned with the verification and the testing of hypotheses derived from theoretical postulates; and the other, the mission-oriented research, being concerned with the problems which require some action on the part of society, not necessarily testing or verifying theory. The kind of research that we might do might incidentally have a great deal of relevance to theory.

Senator Grosart: A bit like the overlap of basic and applied science?

Dr. Dyck: Yes, it is a bit like that. In the area of planning and policy studies, we have launched and are launching a series of projects in four areas. We are at the present time engaged in a series of studies which deal with the planning of human resource development programs; and we are very much concerned with questions about the planning capacity of governmental agencies, the kinds of structures in which planning capabilities might be lodged or housed, the kinds of techniques necessary for the planning of human resource development programs, and so on.

We hope to come up with recommendations which would pertain to the enhancement of the planning capacity of various governmental agencies.

We are starting with our Department of Social Development or Social Welfare as it was known prior to this year and we will move on to deal with planning processes in health, education, manpower—and indeed at the highest level of planning in our province, which is undertaken in the human resources development authority, with which by the way we have no formal connection.

Secondly we are very much involved in planning very elaborate programs of research on poverty. Here we are concerned with the nature of poverty in Alberta.

We hope to develop an empirical typology of poverty so that governments might be aligned a little more to the alleviation of various types of poverty. We will be very much concerned with the effectiveness of government programs in the field of delivery systems in the fields of education, health and welfare when it comes to dealing with the poor in our province. We will be doing a series of studies, one of which has already been launched, cost benefit studies in the area of poverty. Was there a question?

The Vice-Chairman: I wondered if you are in the right committee? We have a committee sitting on poverty right now.

Dr. Dyck: I noticed that. I might say that the Council has representation in several task forces in health and welfare at the federal level, also dealing with the question of poverty.

Senator Belisle: Do you plan to appear before the Committee on Poverty?

Dr. Dyck: We have not planned in this way to this date, sir. I might elaborate on this a

little bit. We commissioned last fall a series of 26 papers, with about 40 professors involved in the development of these papers, assessing social opportunity in the Province of Alberta. These papers were delivered at a symposium held in early April and most of them deal with poverty in one way or another. It is one of the most useful series of papers I have ever seen on any region in Canada.

The papers summarize research and deal with any available data pertaining to inequalities in opportunity, in education, in health, in welfare, in higher education, in professional education, in terms of access to legal services and so on.

Senator Belisle: Would you make those papers available to the committee?

Dr. Dyck: Yes, and I am sure they could be made available to the committee on poverty without difficulty. We would be delighted to, as a matter of fact.

The third area of research we are planning to undertake at this point is in the area of urban development.

I have very little to say about this, because this program is in its very earliest planning stages. We will be co-operating with the research efforts on urban problems emanating from the premier's office, and we will be co-operating with some of the cities, perhaps all of them ultimately, in Alberta, trying to assess their problems and assess various development activities that they have undertaken pertaining again to human resource development activities.

We also are launching as of July 1 a number of studies which have to do with manpower utilization. We have one project under way which is a rather speculative attempt to assess the costs and benefits of a higher level of employment among welfare recipients, for example.

Our Department of Social Development has undertaken a fairly major development project with respect to the employment of employable welfare recipients, and we are involved in assessing this and in trying at the same time to do a cost benefit analysis of what it might take in terms of public expenditures and what the benefits might be, if we really got serious about finding jobs and creating conditions such that many of our welfare recipients who are employable could indeed be employed.

There are several recommendations in Dr. Downey's brief. One of our chief problems, and I am very sensitive to this problem, is finding information about what is going on in the rest of Canada with respect to the areas of our interest. At the present time, it is a very expensive proposition for us to locate, for example, urban research projects all over this country. However, I must say that it is easier in this area, certainly, than in the area of poverty and other areas, thanks to CCURR, the Canadian Council for Urban and Regional Research. They have done a very good study pertaining to Canadian urban problems, and we are very much interested in any efforts to co-ordinate both information pertaining to research and research itself.

Many of the problems we are dealing with in Alberta are not unique to Alberta in the slightest, and we would very much like to enjoy more intercourse with respect to research and the planning of research.

Secondly, we would be very interested in participating in or having developed a more rational or more coherent and more consistent set of guidelines for the conduct of policy oriented research for the nation as a whole. We think that there would be a great saving here, because a good deal of the duplication of effort that now exists would be eliminated.

Dr. Downey makes one further recommendation which pertains to the development of regional human resources research centres. I am really not in a position to speak to that particular recommendation, except to say that there has been a great deal of interest in our organization on the part of governments in other provinces and, indeed, on the part of many federal departments.

We are an experiment. We don't know that this experiment will be successful at this point. At this point we can only hope.

The Vice Chairman: Thank you. If I might just make an observation, Dr. Dyck, you said that your organization had a symposium of some 40 papers presented last April on the processes of poverty in Alberta. Am I right in thinking that these are papers dealing with historical matters and not with the actual solution of the problems?

Dr. Dyck: These 40 professors who submitted the 26 papers—some of them worked in groups—were asked to assess inequality of opportunities with respect to a particular human resource development activity in the

public service, or private services in some instances, such as health or education. They were asked to review whatever data were available at this time pertaining to that problem. Just as important was the question, too, of identifying what they saw to be the major policy and research issues pertaining to their fields, and this was done.

Senator Grosart: Mr. Chairman, I am sure we are all interested in the fact that starting today, really, we are beginning to see that the traditional breakdown of R & D funding between industry, universities and federal Government in house is far from being the whole story.

We added the provincial research councils this morning, and, although their funding appears to be deplorably low so far as the federal Government is concerned, they are unquestionably an important performance sector.

Now we add a new kind of research and development sector today. Here part of the emphasis at any rate appears to be on the planning of the expenditures and political pressures that may be taken to meet some of these problems in this area of social sciences.

I think my first question would come out of what is beginning to me to be a confusion of definitions. From the evidence we have just had it seems to me that human resources is almost completely synonymous with social sciences.

Is that so? Or do we need this kind of refinement in the definition?

Dr. McIntosh: I would say, Senator Grosart, that we could not say that the field of human resources is as broad as the field of social sciences. For example, a very important kind of economic research might deal with Canada's balance of payments problems or fiscal policies or monetary policies. Although we are interested in economic research, we certainly would not be interested in that kind of economic research. We are interested in economic research, though it has some close relationship to the development of people and the development of human resources. I think we have to be very careful in dealing with one resource or the other and in saying that this has some bearing on human development and in deciding in what parts. I think it is a little more confined than the whole broad sphere of social science that you refer to. It gives one the problem of

determining and describing reasonable areas to work in.

Senator Grosart: Well, arising out of that, my next question is, are social sciences a component of human resources or are human resources a component of the social sciences.

Dr. McIntosh: Partially both. When I think of social science I think of certain disciplines like economics and sociology. Many economic resources of course are drawn into the social sciences in certain professional fields such as education, social welfare and medicine. So it draws forth certain social science disciplines or certain parts of social science disciplines and also draws on certain kinds of professional fields that deal with human resources development. It is a melding or bringing together, if you will, of the professional fields and the social sciences.

Senator Grosart: A difficult question arises from the terms of reference of this committee which are broadly to suggest a national science policy. If the federal government reached a point where it could say "we have now funded the social sciences adequately within our means, having consideration for the other claims upon the amount available" then they might be faced with you or somebody else saying "you have not funded the social sciences adequately. What about the Human Resources Council, in the province of Alberta?" I suggest that this is more than a problem in semantics. We just do not know very much yet about the kind of further multiplicity or similar fragmentation of funding that we may hear about in some of the 200 briefs we still have to deal with. Would you care to comment on that? Is there a danger of fragmenting the funding control or discipline (in the broad sense of the word) in the setting up such institutions as yours.

Dr. McIntosh: Let me take a first crack at it before I hand it over to Dr. Dyck to try. If I understand the point you are making, you are concerned that our organization cuts across the standard social science fields. There is, as we have emphasized, a multi-disciplinary or inter-disciplinary approach to human development. Now if we were to look at certain departments of the federal government we would see that they tend to be organized on different kind of basis. When the Economic Resources Development Council mounts an investigation into social problems, we may have to deal with the Central Mort-

gage and Housing Corporation in so far as housing is concerned. If we mount an investigation into the problem of poverty we may have to deal with the Department of Health and Welfare. So our organization would seem to cut across the jurisdiction exercised by very separate divisions within the federal departments and it also cuts across the jurisdiction of various social science disciplines.

Senator Grosart: But my question boils down to this; should we centralize more or decentralize more?

Dr. McIntosh: What are you talking about—centralize or decentralize?

Senator Grosart: I am talking about our national effort in R. and D. Dr. Dyck mentioned, for example, a manpower utilization study. It occurred to me that since we have a Department of Manpower, that department should be doing that study or else it should be doing nothing. If that department is not prepared to make itself competent in the field of manpower utilization by in-house or contract R and D, then they should close up shop.

Let me put it in another way; supposing somebody came along and said "we are funding an Institute of Terpsichorean R and D," and Research—it takes in ballet and ballroom dancing, rhythmic, gymnastics, and music and that sort of thing, so we need a terpsichorean fund." I realize this is an exaggeration and it is a far-fetched example, but I hope it illustrates my question as to how far we should go in the fragmentation of effort into proliferating channels. Now I am not asking this critically; I am asking because I want to learn. At the moment I am a little confused as to how many such organizations we are going to need in the future.

Dr. McIntosh: Well, this is Dr. Dyck's province, and I think he would like to take a crack at it. But before that, let me draw an analogy. We have a National Research Council in this country which serves the physical and biological sciences, and does it very well. This particular organization started with headquarters in Ottawa during the first world war.

Senator Grosart: In 1916.

Dr. McIntosh: In 1916. And so it has been in existence now for some 50 odd years. During the course of its existence it found it

appropriate, necessary and desirable to decentralize its activities. For that reason we now have a Prairie Region Laboratory, to deal with prairie problems, and an Atlantic Regional Laboratory to deal with Atlantic problems. But these are direct extensions of the parent organization here in Ottawa. Now let us extend this to the social sphere. It would seem to me that in the example which you used of the Department of Manpower and the expertise which it should develop in the fields of manpower, training and reemployment, it would be something that we would wish to do; that we should work co-operatively with the Department of Manpower when there appeared to be a problem which we would best be able to handle. So that on a contract or commission basis we could take over a problem from the Department of Manpower if we have the people who can do the job and if they did not have the people for that particular job.

Senator Grosart: Maybe they would not have them because you would have them. This is one of the problems of fragmentation. It seems that you run counter to the concept of centres of excellence in research.

The Vice-Chairman: Senator Belisle.

Senator Belisle: Dr. McIntosh referred to the fact that this was a Crown corporation operating mainly with provincial money. Do you not receive any money from industry at all?

Dr. McIntosh: Our organization is not equipped to handle and our mandate is not such as to make it likely that industry in Alberta will find it appropriate to call on us. Certainly they have not called upon us to date, nor have we any close relationship with industry in the province of Alberta. There is the Research Council of the provincial government which does a good deal of research on industrial problems.

To answer your question directly, we do not have funds, nor have we sought funds from Alberta industry, nor have we really considered that possibility. Our legislation does make it possible for us to accept funds from sources in addition to the provincial government, and we are making attempts to do that at the present time.

The Vice-Chairman: Is it a fair question to ask you how much money has been made

available for your council from the provincial government?

Dr. McIntosh: Yes, I think that is a fair question. I think our budget for the coming fiscal year is of the order of three-quarters of a million dollars. I may be \$10,000 or \$20,000 out on that, but it is of the order of three-quarters of a million dollars, in our first full year of operation.

Dr. Dyck: I might say, however, to supplement that, that I mentioned Premier Strom's announcement with respect to a major effort in urban studies, and, what I did not mention, his announcement with respect to an education commission. We will be serving in a fairly major way both on the education commission and on the council for the research effort, and we will be recompensed in one way or another for these.

The Vice-Chairman: I think \$750,000 is a fairly good start in nine months.

Senator Belisle: Would that be mostly for personnel?

Dr. McIntosh: It would be mostly for the support of research. Our staff has been kept deliberately small; we have a small in-house staff, numbering no more than 25 persons, during our first full year of operation beginning this autumn. The funds we have been provided with would be two-thirds for support of commissioned and grants-in-aid research to be carried on by scholars, in the Alberta universities largely.

Senator Belisle: But you are using that yourselves eventually in the universities?

Dr. McIntosh: Yes, very much so.

Senator Belisle: Are you building yourself a new empire?

Dr. McIntosh: No. I think the intent of the policy established by our board of governors is not in any way to build up a parallel kind of capacity for research to that at present already in the universities. We are making a great deal of use of the social science scholars and scholars in professional fields, such as education and social welfare, in the Alberta universities, and we will only build up our staffs to the extent it is necessary to plan and co-ordinate research activities in the social sciences in the province. Secondly, there are certain kinds of effort required in in-house staff, particularly the developmental kind of

efforts which, in my view, are not the province of the university.

Senator Belisle: In answer to a question a while ago you said you are second and Ontario is first. Do you compare notes with Ontario?

Dr. McIntosh: Yes, we compare notes, and we also raid staff from the Ontario institute.

Senator Belisle: And are you making the same studies as they do in Ontario?

Dr. McIntosh: We hope we do not conduct the same studies. Our policy is such that we co-operate as much as we can with research centres of a comparable kind, not only in Canada but also in other parts of the world, particularly in the United Kingdom and the United States. We definitely do not duplicate studies. We think one of our purposes is to so develop an understanding of what is going on in social and scientific research and so to disseminate information that duplication is kept down to the bare minimum.

Senator Carter: What is your relationship to the provincial Research Council of Alberta?

Dr. McIntosh: That is a research council in the physical and biological sciences.

Senator Carter: You have divided the two fields between you?

Dr. McIntosh: The Research Council of Alberta was created much earlier than us, in the thirties, and so they have been carrying on for some 35 years. We were created somewhat after their pattern. We are not housed in the same building, and we have separate boards of governors and, so far as I am aware, we have very little communication between the two organizations.

Senator Grosart: Their field is applied science?

Dr. McIntosh: Yes, applied science—engineering, and so on and so forth.

Senator Carter: So you have done something like the Macdonald Report has recommended should be done nationally?

Dr. McIntosh: I have very superficial acquaintance with the Macdonald Report, but I understand it asks for a continued kind of federal involvement in the social sciences such as exists in the physical sciences at the present time. In that sense, that is right.

Senator Zuzyk: What type of projects have you carried out, and what types are you carrying on now?

Dr. McIntosh: It would be a rather lengthy list, but I could take one or two examples of the kind we are carrying on, and perhaps Dr. Dyck would like to supplement my answer with some of the work you are doing.

Dr. Dyck: First of all, we have the grants-in-aid program. Fifteen projects were funded in our first competition. These are projects falling within the scope of the Human Resources Research Council and are projects of which some are high risk, and to see whether something fruitful can come out of a given project, wherein this area can be developed in the future.

Senator Zuzyk: Who sets up the project?

Dr. Dyck: Mainly professors from universities in Alberta, as well as other provinces. They submit proposals which are evaluated by an outside committee made up of eminent scholars, and are funded accordingly. We are having another competition this fall.

Senator Grosart: Could you name some?

Dr. Dyck: There is a base line study, a demographic study of Alberta cities. There are three projects dealing with regional development in the province.

Dr. McIntosh: I should mention the Alberta native history project, which is a project directed towards developing social studies curricula and other kinds appropriate to the Indian and Metis youngsters who at the present time do not have curricula which will tell them a great deal about their own culture and way of life.

Senator Grosart: Give us a few more short titles.

Dr. Dyck: One deals with the linguistic problems that Indian children face when they move into integrated schools. This is in British Columbia.

Dr. McIntosh: Problems faced by the older person—this is not the exact title, but having to do with problems faced by the older person.

The Vice-Chairman: Dr. Dyck, you referred to provincial research. Do you not think there should be some involvement between your Human Resources Research Council and the Human Resources Commission of the Prov-

ince of Alberta? I think you said there has been no formal association.

Dr. Dyck: I meant, any legal connection at this point. The development authority, as I understand this legislation, is designed to master plan, if you will, at its highest level of planning and co-ordinating, human resource development programs. At this point in time both the development authority and the Research Council are very young and the working relationships have not yet been established. We hope that they will be in the future, and we think that we will develop a very intimate relationship with the authority.

However, at the present time in our planning research we are working primarily with the given departments with respect to our poverty research at this point of time. We have no connection with the development authority. We are developing ideas for the poverty study facing it, and this is a case of where we may commission the research and have it done under our direction, if it seems most economical and desirable to do so.

Senator Carter: Can you give us some idea of what kind of study you are going to carry out with respect to poverty?

Dr. Dyck: With respect to poverty the first phase will probably—and I say “probably” because the planning for this study will be completed by mid-summer—be an attempt to develop a more accurate and more realistic conception from data that the poor people give us, by means of some kind of a survey or interview, of various types of poverty that we have in the province. Perhaps I might draw an analogy at this point and say that when it comes to dealing with the mentally ill we have many categories of mentally ill. We have a feeling—and it comes from what many of these scholars tell us—that we are not refined in our public policy sufficiently to cope adequately with poverty. We are not refined in our conception of the different types of poverty.

There are different types of people who have different unemployment experience, different family experience, different community experience, and so on and so forth. We think that we need to develop a more accurate conception of the different types of poverty that we have.

Senator Carter: Are you starting out with a definition of poverty, or are you going to evolve a definition?

Dr. Dyck: The definition will be evolved empirically from our information.

Senator Yuzyk: Would you deal with poverty of the mind too?

Dr. Dyck: If I might just continue, the second phase of the project will be an assessment of the mechanisms and means by which services are delivered to the poor—health, legal service, welfare, education, and so on.

The Vice-Chairman: Housing?

Dr. Dyck: Yes, housing, and community development—those sorts of services. These assessments will take various forms. One will deal with communication problems, for example. Another will deal with an evaluation of costs and benefits.

There will likely be a third phase to this particular project in which we will become a little more general again and try to evolve a realistic set of guidelines for the treatment of poverty and the reorganization of various departments and institutions to cope with poverty. We will try in our first phase also to assess the gaps in programs, and in the second phase we will try to assess the ineffectiveness of the existing programs, or the effectiveness of certain programs.

Senator Haig: What will be the relationship of this study to the study being carried out by the Special Committee of the Senate on Poverty?

The Vice-Chairman: I just asked Dr. Dyck if he was sure he was not in the wrong committee.

Senator Carter: Recommendation No. 3 on page 5 is:

That the federal Government commission an inquiry into the social science and social policy research capabilities of the nation with a view to establishing guidelines for growth and development, to reducing duplication and fragmentation, and to the creation of appropriate linkages in information systems.

I had the idea that this was what this committee itself was trying to do. What are we leaving out that you think should be included?

Dr. McIntosh: The question, I think, is a very good one, but I do not have a satisfactory answer to it. I think that that is, in fact, the task of this committee.

Senator Yuzyk: Were there any projects assigned by the Government of Alberta?

Dr. McIntosh: Indirectly, sir. As Dr. Dyck has mentioned, the provincial Government has already commissioned one major study and is about to commission another. The one study which has been commissioned is that on educational planning in the Province of Alberta. This is going forward under an independent commissioner, but the independent commissioner will make extensive use of the staff of the Human Resources Research Council as research staff in preparing this study. The study, although it was a study commissioned by the province, was one that they asked us to design, and we were, in fact, extensively involved in designing the study.

The second study is that on urban problems, and here again we are very much involved in advising the Government on what form the study should take, and we will be much involved in the carrying through of this study as well.

Senator Yuzyk: You set up the terms of reference, do you?

Dr. McIntosh: I do not think we can state it that positively. We have advised on the setting up of the terms of reference for the education study, and we are doing the same thing for the urban study, but the Government, of course, makes the final decision.

Dr. Dyck: I might just add that we have at this point so far in the history of the organization a great deal of autonomy. For example, to take this urban study as an example, we are now trying to decide what the Human Resources Research Council wishes to do in urban studies, and to develop study guidelines or policies for research which we want to undertake.

If the terms of reference that the provincial Government develops fit in with our statement of policies and objectives in this field then, of course, we will co-operate in whatever ways they wish, but at this point we do have a great deal of autonomy, and whether this will continue in the future is, of course, a question.

Dr. McIntosh: I might add that independently we had great interest in the studies in which the Government has shown a great interest. Educational planning and urban development are areas in which we must be

involved. The Government also feels it must be involved in them, so there is a very nice meeting of interest here.

Senator Yuzyk: You must get personnel and researchers for definite projects. How do you go about securing them?

Senator Haig: They steal them from Ontario.

Dr. Dyck: Well, we steal them from a number of places. Each of the people on the staff has connections in various universities across this country, the United States, and even in Europe. For example, we are getting two economists from Princeton, a statistician from Harvard, and a person from the Ontario Institute of Educational Studies.

Dr. McIntosh: Even a few from Alberta.

Dr. Dyck: Yes, indeed. We are still looking for personnel. They are always difficult to come by, but the idea of this council excites many of the young people who are now in their Ph.D. programs.

Senator Yuzyk: I am interested in knowing the Canadian composition of your personnel.

Dr. McIntosh: All but two. As a matter of fact, I myself, although from Harvard, am a Canadian from Saskatchewan. I am proud to be from there, and I am proud to come back. We are doing this with a number of our staff members who are coming out of graduate programs in American universities. These are people we had known back in Canada before they went off to graduate school.

I might add that in our organization staffing is a continuing problem, and I suppose the same applies to other research centres. This is one of the reasons why we have adopted the strategy of using commissioned research and making as extensive use as we can of scholars who are already in universities in the Province in Alberta.

Senator Yuzyk: Do you hire staff for a considerable period of time, for three or five years? Do you have permanent staff?

Dr. McIntosh: No, we do not. We are all on short-term contracts. In fact, I believe we are all on one-year contracts to as long as three-year contracts. The intent is that the organization, at least as we presently conceive it, will not have a permanent staff with tenure in the same way a university would have. Our organization is project oriented; we bring

people on our staff for the purpose of carrying through a project or solving a certain problem, at which stage they return to the university or to wherever their previous employment was.

The Vice-Chairman: May I just say that this afternoon we have three groups here, and I want to be fair to the others. Unless somebody has a very pertinent and pressing question to ask now, I would suggest that we retire Dr. Dyck and Dr. McIntosh, with the idea that after having heard the others it will be a free-for-all. I should like to get finished not later than quarter to six if we can.

Senator Grosart: I should like to ask one question, because it is on the rationale of this sort of institute within the federal R & D framework. I think it is important to get an answer from these witnesses, because this is the only institute of its kind that will come before us. Recommendations 2 and 4 indicate that the council suggests federal funding of its own and similar activities. In the partial list of projects that we were given we have studies in regional development, and we have a Department of Regional and Economic Expansion; there are two concerned with native populations, and we have a Department of Indian Affairs; another refers to urban demography, and there is a good deal of work in that in DBS and elsewhere. We have also been told that two-thirds of the funds of this particular agency are expended in either grants-in-aid or commissions. Would it make sense for the federal Government to fund an agency, which in itself would then fund other agencies; and how does the federal Government decide whether to do this through the province and its Department of Education or its matching departments, or through its own departments? Again I come back to fragmentation. I agree that the more studies and R & D, the better the plan, the better the operation will be, but at some point the question of how many studies are needed before political action is taken in that particular field has to be considered?

Dr. McIntosh: I think we have to make very clear exactly what we see the purpose of our organization being. I think the purpose of our organization per se is to do the planning and coordinating, the mounting and the development of projects. When we talk about the great deal of work we do through grants-in-aid and commissions, we should make very

clear that these are done within the guidelines we establish for priority research problems that we want attacked, and we define what these problems are. To enhance our research capabilities we seek out research talent wherever we can find it, often through commissions that we then make to Alberta university scholars. We are not simply a fund disbursement agency by any stretch of the imagination.

Senator Grosart: But two-thirds of your funds are disbursed in commissions and grants-in-aid.

Dr. Dyck: For this first year.

Dr. McIntosh: We have to differentiate between the grant-in-aid and the commissioned research. The grant-in-aid is clearly a means of seeking out ideas from independent scholars in Alberta universities, and in universities outside the province incidentally. We want to have a grant-in aid program, because this is the way we can stimulate scholars in the field to bring to our attention the kinds of priority researches they see, so in a sense it is an entrepreneur type of activity on our part; we are sparking research done by independent scholars as to one-quarter of the total amount of fund disbursements we make. The other three-quarters is in the form of commissions to do jobs which we define, and projects we do the conceptualizing for. We define the project, but rather than taking people full-time on our staff for an extensive period of time we commission people to do the work. It is difficult to take people on because of the scarcity of manpower in this field and because it detracts from the teaching capabilities of universities.

We make use of university scholars through commissions. These commissions are within the framework of studies which we define with very specific kinds of goals and objectives. In other words, we hope that by doing so we will overcome part of the fragmentation problem you are referring to.

Dr. Dyck: Speaking of another aspect of your question, with respect to fragmentation and duplication, we are in contact with manpower and many agencies and are becoming quite knowledgeable about the research projects they have funded and research projects that they have done in the past. Projects we undertake are not, at this point, duplications. This was, for example, urban in the area of research. Part of my mission here

is to scout and find out what is going on with respect to urban research in Ottawa. We do not wish to duplicate. We do not wish to do work that is now in progress, but there are so many problems that are unique to given regions that we feel quite justified in undertaking them—for example, problems dealing with poverty, manpower or urban studies.

The Vice-Chairman: As a new organization, Dr. Dyck and Dr. McIntosh, I presume that you have examined the inventory of research projects in your fields in Canada.

Dr. McIntosh: We are in the process of doing what will be a continuing and very large job, but it is certainly one in which we see as having high priority.

The Vice-Chairman: You do not see it as an impossible task to provide an inventory of research projects in the human resources field.

Dr. McIntosh: We hope it is not an impossible task. It is a very large task.

The Vice-Chairman: I think, in fairness to the other group, we must discharge you for the moment. After we hear from them, there may be questions directed to you, because we are going to be dealing in related fields this afternoon. I would like to thank you at the moment for your presentation.

We are pleased to hear now from the Canadian Teachers' Federation, represented by the Deputy Secretary-Treasurer, Mr. Norman Goble, and the Projects and Information Officer, Miss Geraldine Channon. We have received copies of your brief and you can be assured that it has been read by members of the committee. I suggest, Mr. Goble, that you make a brief statement in the way of a precis of the brief. Is Miss Channon going to take part in the discussion?

Mr. Norman M. Goble, Deputy Secretary-Treasurer, Canadian Teachers' Federation: I would like to be able to call on Miss Channon to reply to some of the questions which may be beyond my competence.

As you suggest Mr. Chairman. I would not want to take the time of the committee members to repeat what they have read. I would like to make one or two illustrative remarks about the two main points we are making and then invite questions. It may be helpful sir, if I begin by making it quite clear from whom we have our warrant. The

Canadian Teachers' Federation is a federation of all recognized associations of teachers in elementary and secondary schools in the provinces and the territories. The sole exception at present is the Corporation des Enseignants du Québec, the French-speaking Catholic group in that province. The federation was formed as a means for these organizations to act in concert or to speak with one voice whenever the occasion arose to do either of those things.

Now, sir, we have limited our presentation to two points, not because there are no others on which we have opinions but because these two seemed to be most decisively within the areas of our professional interest and the interests of our constituents.

Our first point is to stress the dependence of science in any country on the quality of science education, and the importance in that connection of science education at the level of the elementary and secondary schools.

We are, believe me, sir, in our position as a national federation, inevitably and sensitively aware of the problem of jurisdiction. This is one of those areas in which you have the difficulty of acknowledged national needs which are more than just a composite of provincial needs, national purposes that are more than an agglomerate of provincial purposes, with, on the other hand, the difficulty of a divided jurisdiction under the constitution.

I know, sir, that I am referring to something which, to this committee, is a familiar and vexing problem. You all know that I am aware of the implications when I say it becomes more and more necessary to find an effective mechanism of partnership which will make it possible to pursue national goals through the agency of provincial authorities in collaboration with that one government which has an undivided responsibility for the quality of Canadian life from coast to coast.

Education in a province is not education for that province. This is increasingly true with the growing mobility of the Canadian society, and it is perhaps most true in the field of the sciences.

This is the dilemma that confronts us here, then, the general Canadian responsibility, the general Canadian need, and the division of jurisdiction among the ten autonomous and sovereign provinces—sovereign, at least, in the domain of education.

The problem in this dependence of science on education in school at the primary and

secondary levels is particularly the problem of the obsolescence of knowledge among teachers of science. I would stress, to clarify a point in our brief, that we are not talking here just about the private problem of the individual, open to solution through the exercise of his own initiative. We are not just talking about the problem that a teacher may solve by using his summers wisely. We are talking about the inadequacy of the provisions in Canada for a teacher to do just that: the absence of appropriate courses in appropriate institutions.

There is a great need for courses which will provide for the science teacher not only a general refreshment of his own knowledge but a strengthening of the relevant aspects of his knowledge, and that is something quite different.

Science courses in universities are rarely appropriate to the science teacher who is seeking a general understanding of the relevance of new discoveries, new directions in science, that he can communicate to his students. He needs courses that will be a distillate of scientific discovery and new scientific knowledge so that he can go back to his school with some greater coherence established in his own understanding of science and with the possibility of teaching his students some comprehension of the general directions of science. This is important not only for those who are going to be science specialists and want to understand the meaning of the scientific disciplines that they are drawn towards, but for the general student who is interested in the relationship of science to life.

Our second point is that we question the reality of the distinction that is made between the physical and human sciences.

The whole history of science has been a history of the transfer of disciplines from what we now call the field of arts into what we now recognize as the field of science.

Most of our sciences began as speculative or conjectural philosophies and eventually became objective studies; and the derisive moment in each case was the discovery of appropriate instruments of measurement that made it possible to move from one field to another.

We are suggesting that this process be recognized, that it be recognized that the human sciences which are components of

"education" science such as psychology, sociology and anthropology and other related fields have reached a stage of organization and structure where they are able to apply the methodologies that are familiar in the physical sciences and where they should be recognized as part of the world of science.

We are suggesting, particularly, that if recognition is given to education and its component human sciences as lying within the field of science, there is need, in the national Canadian interest, for the improvement first of all of facilities for active research—research in the field, out of the laboratory.

It is true of all sciences, and perhaps particularly true of education, that if research and study are to have any real meaning, the hypotheses, the hypothetical postulates that Dr. Dyck referred to, must be derived from observed phenomena, from what really happens, not just put together from convictions of a sentimental or philosophical order.

There must be, then, access to the observation of education in process, for effective educational research projects to be constructed. There must be access to the classrooms, to children in learning situations, for immediate testing of theories derived from research. There is a great need also for integrating the different fragmented aspects of educational research, by bringing them together into the setting of field research projects.

Secondly, in this area, there is a most urgent need for dissemination of the results of research.

One of the hardest things in this country is to find out what has been found out; and the next hardest thing is to find out what, having been found out, has been tried; and the third thing is to find out what it was that happened when whatever it was that was found out was tried.

There is a vacuum of knowledge. There is a most urgent need for something comparable to what the Americans have set up—the ERIC system for the dissemination of information—to be set going in this country for Canadians.

At this point, I might invite questions.

Senator Carter: I was planning to put this question to the Council for Research in Education but I wonder if the witnesses could give this committee the answer. He says it is difficult to get information. I wonder if he could give this committee any idea as to how much

is spent on educational research in Canada in any one year?

Mr. Goble: In a moment, sir, I shall ask Miss Channon if she could help me out in this. I would say this is one of the extremely difficult things to discover, because of the lack of centralized information.

The amount is, by any standards of comparison, pitifully small. I am reminded of a remark made by the first Director of the Canadian Council for Research in Education. The Canadian Council for Research in Education was, if you will pardon the indelicacy of the figure, conceived in the womb of the Canadian Teachers' Federation. Dr. Floyd Robinson, who was research director for CTE, became first director of the Canadian Council for Research in Education when it achieved independent life. He made a remark at one time that there were twelve times as many people employed in studying fish as there were people studying research into education. I do not want in any way to depreciate the importance of fish or to speak disparagingly of them.

Senator Haig: Especially to Senator Carter.

Mr. Goble: Indeed, I use them as a measure of importance. Perhaps Miss Channon will be able to give us some idea as to the amount.

Miss Geraldine Channon, projects and information officer, Canadian teachers' federation: I cannot give the amount. But I think it is important to point out that there is so much variation from area to area in the amount. If you look at Ontario you will see that there is quite a substantial amount of money going into research not only in the Institute but at the level of school boards and so on. In the west also there is a growing contribution particularly in Alberta and British Columbia, but in the east there is very little.

Senator Carter: Can you give us for any one province how much is devoted to educational research?

Mr. Goble: At the top I think stands Ontario where the Ontario Institute for Studies in Education has a total annual budget of the order of \$12 million. Most of the large school systems of course employ some research staff and there is no way of knowing exactly how effective their work is or how much goes into it and particularly there is no

way of knowing how much financial support goes into research in that field. Here of course definition is a problem. You may want to include, for example, the work of the Atlantic Development Board in studies in education as one of the components of the economic development of the Atlantic region. This represents an investment by the government of Canada of perhaps \$3 million in the last couple of years. I am not sure of the figures, but there is nothing in any of the other provinces and no one of the other provinces has an agency that has at its disposal anything like the budget of the Ontario Institute for Studies in Education.

Senator Carter: How many institutes are there in Canada carrying on studies into the teaching process and the learning process?

Miss Channon: I think you have to look at the graduate school situation and to look at the universities which operate graduate programs to find out where research is being done. I don't think there is an institute quite comparable to the Ontario one anywhere else. One was proposed for the Atlantic provinces, and I think the idea may be reborn but it has not come to pass yet.

Mr. Goble: There is of course work of this nature being done in the faculties of education in Victoria, Simon Fraser, U.B.C., Calgary, Edmonton, Manitoba, Macdonald College and the universities in the Atlantic provinces, but by putting it this way in the form of a catalogue I think I may be helping to illustrate the kind of fragmentation that is a problem. Much of the work being done is in the form of Master's and Doctoral theses. This makes up about 90 per cent of the work being done. It is very difficult to know what the content of a few hundred theses in the course of a year is. Just the problem of indexing the publications that carry the digests of research studies and so on is a very large problem. The Canadian Council for Research in Education has been doing this and CTF has been doing it.

Miss Channon: There is a list of theses prepared by the Canadian Education Association. There is a central list available.

Senator Grosart: There is a list in every university. Every university I know has a list.

Miss Channon: They also go to the National Library.

The Vice-Chairman: Would you not think when we are trying to evolve a national science policy which is obviously going to be very costly, that it is imperative that the components of the national picture be known, that somewhere an accurate presentation of how much each component is spending on research be made? There are many Ph.D. theses with the cost being carried at the individual's expense; he may have a grant or he may not have a grant at all. However, there are others that are very costly projects. Surely, somebody should be trying to tie these things together, so that we can have a national picture of what is being spent on educational research?

Mr. Goble: There is another aspect to that. Some or many of the topics for research are chosen simply because they will not cost much to do. This is not really the way to establish priorities. There is no way, in fact—there is no mechanism at present for determining priorities of importance or urgency in educational research. In such a situation of total fragmentation the graduate student is limited in his choice of research projects by the relative accident of geographic location and the funds available in that location, and by the facilities for study that are available. If someone at Memorial, for example, comes up with a very good idea for a research project that requires \$750,000 to do and requires access to students in the differing conditions of four different provinces, he might as well forget it.

Senator Grosart: This seems to bring up the old problem that we are not able to get the answers we need. It seems extraordinary to me that the Canadian Teachers' Federation, coming before a Senate committee on national science policy to discuss research, educational research, would say to us, "It is too hard to find out, to answer the simple question as to how much is being spent." Everybody says everybody else should be doing research, that the federal Government should be doing more research and funding more research; but we do not find all these organizations doing research themselves. It is incomprehensible to me that the Canadian Teachers' Federation is not able to tell us this.

I know there are problems, but if it is impossible for the Canadian Teachers' Federation, with the intense interest they have in this, to be able to find the answers, we might

as well give up the whole problem. One hundred letters written by the Canadian Teachers' Federation would get enough answers to be able to answer that question. It is difficult, yes, but a hundred letters written tomorrow will get you an answer to that question. Why do we not have it? It is all very well to say the other people should be doing the research, but you have come here, before a Senate committee; supposedly prepared to answer questions and you are asking for federal funding. What is the dimension of it? You say it is pitiable. We ask, how, in relation to what? That is our problem here. I do not want to pick on you, because we are up against this over and over again.

Senator Carter: I would like to follow up with a question of my own. I have many more questions here, but I will give somebody else a chance after this one.

Can you tell us about any research project that has been carried on in Canada, that is going on at the present time or that has been carried on in recent years, related to the teaching process, to the learning process, to teaching aids or learning aids, or to educational research generally—any projects that you know of?

Miss Channon: It is difficult to list them just off the top of one's head, but to answer the last part of your question first I would say that there is a study of research capabilities going on in Quebec under the IRP at the present time, and it is hoped by the CCRE that it will be possible to conduct a similar study in the rest of Canada to determine the research capabilities that exist in education. There have been a variety of studies of television programs of instruction. I might even point to several CTF studies in the area of programmed instruction several years ago in which we set up what you might call a demonstration project and showed teachers how to evaluate the effects of sample programs in research terms, we have several reports out on this.

There are various other studies of methods in reading and mathematics instruction, and so on, that have shown up in graduate theses. There have been some interesting staff studies in educational planning. Is that enough?

Senator Carter: Yes, but you did not tell me where this has been going on, except that there was one study conducted in Quebec. What about these research capabilities? Just

what is that? Is this research into research capabilities?

Miss Channon: Yes, I think the idea is to find out who is employing people who are capable of doing research in education, and how much they are getting from their institutions towards research. I am not certain of all the details of the Quebec study, but I think a national study would try to find out how much of the time of people supposedly in research is actually devoted to research.

Senator Kinnear: I should like to ask a supplementary question. Have you any way of finding out the skill of your teachers. We have heard it said here that we have teachers who are not very skilled in teaching science. Have you any way of grading the teachers who will be teaching science?

Miss Channon: I think you have asked a crucial question in research. We can quote thousands of studies by which they have attempted to find a key way of measuring teacher competence, and no one, I think, would say that it has been found. But some work has developed in the analysis of what happens in the classroom situation which suggests that there will be a breakthrough in this area which will allow for a scientific measurement of teacher competence.

Senator Haig: That is the basis of the merit system, to which the teachers object?

Miss Channon: No, rating scales are the basis of the merit system, but rating scales have not been found to be a satisfactory means of rating teacher competence. I might say that this question is involved with what are the aims of education, what are the behavioural objectives for students, and what is it that teachers actually do that helps students achieve these behavioural objectives or aims, insofar as we are agreed on the aims, and I do not think we are really completely agreed here either. These questions are all bound up together; none of them is completely settled or even close to settlement, but there is a little light.

Senator Belisle: I should like to ask a question of Mr. Goble on the first page of the brief. I know that in your comments you were very careful, but in the first paragraph of your brief you say:

Recognizing the problem of reconciling national needs with the exclusive jurisdiction of the provinces in education...

My question is this. Has any research been done by the Canadian Teachers' Federation to find out the opinion or consensus of opinion as to whether the education field should remain the exclusive property of the province?

Mr. Goble: No, sir, we have not done this. The reason for this is in our structure and constitution. We were set up as an agency by the joint will of the provincial organizations, and this is the kind of area in which we operate within policy. It is an area policy that we cannot regard as a matter of objective research, for reasons that you will understand. I was about to add a statement of opinion, but I think it might be more discreet if I did not.

Senator Grosart: The politicians have opted that research area.

Senator Belisle: What did you say, Mr. Goble?

Mr. Goble: I was being discreetly silent when on the point of adding what would not have been so discreet.

Senator Belisle: But in your statement you said the education given by a province is not any more the education for that province.

Mr. Goble: Yes.

Senator Belisle: There is a political context in that.

Mr. Goble: There is. I think I can safely say it is the consensus of our associations that there is a distinction here that must be made more often, more clearly and more emphatically. There is no dispute at all about the sovereignty of the provincial legislatures in the organization and administration of education.

Senator Belisle: I agree there.

Mr. Goble: But the product is for the benefit, not of the province, nor even it should be said, I suppose, for the country, but for the whole human community. Certainly it is quite unrealistic in our view to interpret the exclusive provincial jurisdiction over education as a statement that education belongs to the provinces in every sense.

Senator Carter: Could I follow on from there? I see that in paragraph 2(a) you recommend a national advisory body, and the purpose of that body would be to establish Canadian policy guidelines in science educa-

tion. How would you expect a national body to establish guidelines for education in any subject when it is really under the jurisdiction of the province? Do you expect a consensus among all ten provinces on education?

Mr. Goble: What we are suggesting here in paragraph 2(a) is really a conference situation in which we would hope there would be some successful effort of persuasion. "Consensus" is, I suppose the most appropriate word. We hope that it would be possible to arrive at some general understanding of the needs of Canada in science education, and not only that, but beyond that an understanding of the part each province might play in meeting the general need.

Senator Carter: Let us follow that line of thought a little further. You committee has agreed on something; you have reached a consensus that the guidelines of science policy should be so-and-so and so-and-so. That is fine possibly for Alberta, and possibly fine for Ontario, but it is beyond the reach of the Maritime provinces, the poorer provinces. How do you see the gap being filled?

Mr. Goble: This leads us into paragraph B where we are proposing a permanent planning committee to devise means of insuring that provincial educational provisions in the aggregate meet the national needs, and that the resources of the provinces are supplemented as necessary to achieve this end. This would cover such matters as financial equalization.

Senator Carter: How can the national funds be used in this way unless they are earmarked for it?

Mr. Goble: To attempt to specify an answer here is to anticipate the findings of the kind of bodies we would like to see getting into operation. I would take that risk anyhow and suggest that the approach we would like would be by way of an agreement between the provinces and the federal Government to provide the necessary facilities for a particular enterprise, with a request for funds from the federal Treasury—not the federal Government or, I should say, the Canadian Government. I have a personal prejudice against the misuse of the word "federal" and I do like to make it a point that when I am referring to the Canadian Government it is a unitary Government in its own domain of responsibility.

We would never suggest that the Government of Canada should take the initiative in saying "This is a need; there is a good place for it; and we shall give you the money if you agree to put what is needed in that place." By persuasion and joint consultation we could bring about a situation where the provincial governments will willingly co-operate in this kind of thing.

Senator Carter: I do not quite see how this can be done in practice. Let us say the Maritime provinces come to the federal government—the Canadian Government—and say, "Look, we have a nice consensus. All of the provinces have agreed that our goals should be so and so, but to achieve these goals we need X dollars for more buildings and equipment and we do not have it." The Dominion Government will say, "Fine, but we gave you an equalization grant. Instead of using this for education—we put you on a par with the others—you have gone off and used it on roads or something else to pay a little more political dividend." How are you going to overcome this kind of argument?

Senator Haig: That would not apply to Newfoundland.

Senator Carter: Only Manitoba.

Senator Bourget: I think it is a difficult question to answer. It is a political question.

Mr. Goble: It is hypothetical.

Senator Carter: I do not think it is hypothetical, because it is happening.

Senator Bourget: It is interesting, but I think it is difficult to have that kind of question.

Mr. Goble: I do believe that it happens more now because the opportunities for consultation are not yet what they should be. I am getting speculative now. I think we have to have faith that with more consultation and more conference among governments we can reach this kind of agreement, because this is the only way in which our Constitution...

Senator Bourget: We all know that.

Senator Grosart: Are you not really suggesting, as the answer, that if educational research were to be regarded as part of the national science policy you would not have to worry about "education", you would just call it research. This seems to be the point you are making on page 2A:

That any general science policy developed, include the behavioural as well as the natural sciences.

What you are really saying is—what is the difference, as you say, somewhere else—between funding the teaching of rats and the teaching of children. I think it is in your brief.

Mr. Goble: Yes.

Senator Grosart: That makes the point, which is exactly the point.

Miss Channon: Page 7.

Senator Grosart: You say education and research both draw from the behavioural sciences and contributes to them. It seems inexcusable that it should be kept away from sources of funds devoted to the behavioural sciences. You are going one step further and are making the point that not only are the behavioural sciences excluded from the general definition of science, but education tends to be taken out of the definition of behavioural sciences.

Thus it seems inexcusable that it should be kept away from the source of funds devoted to the behavioural sciences. The absurdity becomes more apparent when one notes that funds are available for the study of the learning patterns of rats, pigeons and guinea pigs, but not for the study of the learning patterns of children in school classrooms.

The Vice-Chairman: I think that statement is the highlight of the brief.

Senator Grosart: It is in that area that the federal Government is today finding the answer. It is funding education at the post graduate level and saying that this is not education. What you are suggesting is do a little more of this, and to me that makes sense.

The resistance of the provinces as this is developed, is lessening under the impact of certain hard dollar realities of our system of government.

The Vice-Chairman: I am wondering if the recommendation of the MacDonald Report, that a social science research council be established—which would include education, of course—might not get around this very point you have just made. It might set aside funds for education in the social sciences, and then

it would be up to the authority, whether it be a ministry of science or an advisory council, to allocate the funds for X number of projects.

Senator Grosart: To come back to the point I was discussing earlier about the total amount that the CCRE—the Canadian Council for Research in Education—had in their brief—they are not here—they dealt with this problem. They estimate that the total spent on education in Canada today is \$6 billion. On page 6 of their brief they say that the proportion or percentage of that, devoted to educational R and D in the United States, is about a half of one per cent—the proportion of the American funding of education.

This would give a figure of about \$30 million as a reasonable target for the funding of educational research in Canada.

While I am on that, I notice that, while you are not confused, you do go back and forth in your report on science research, from research in the science of education, to the other topic, which is the research into teaching of science. These are two topics that are hard to separate in terminology.

Mr. Goble: Mr. Chairman, I wonder if I might comment once again on this matter of funding and the problem here. I do not want to seem to be defending myself, and I do appreciate the frustration of the committee in regard to the absence of exact figures.

I have to point out that the Canadian Tax Foundation has been unable to find out how much money is spent on education in Canada. This is because of the difficulty of definition, of identification, you have all the different Government departments sponsoring projects that do not even have a title that marks them as research, and these programs multiply.

Senator Grosart: But you cannot reject research because you have all these problems. That is what makes it research, the fact that you have these difficult problems.

Mr. Goble: If we had some such organization as ERIC operating in this country, it would be easier to find out the answer to the fundamental question of who is spending money on what. Right now it is buried across the country in thousands of parcels.

Senator Grosart: In the United States they have taken the centralization away, through a department which they call HEW, meaning Health, Education and Welfare, which constitutes the same broad description of human

resources, that we were given by the previous witness.

Senator Carter: Mr. Chairman, yes, surely you can get over it by research, because you can have educational research under social sciences research and humanities research, but the point I was making was that these guidelines are in science education. They are not in education research but are in education. That is the point and that is why I raised it.

Mr. Goble: This is where we do see a distinction that the committee may not share our view on. This is relevant to a point raised earlier. When we are concerned with the research efforts of the individual scholar, or of a group or team of scholars, we would see it as entirely legitimate that the scholar or scholars approach agencies of the Government of Canada and receive direct grants. But when we are talking about an educational improvement that needs or requires either the provision of an institution or the expansion of institutional facilities or the provision of formal upgrading procedures for teacher qualifications, then we are in the area of legislation and regulation and in the area, in our view, of exclusive provincial jurisdiction. So here all we see being possible is the establishment of agreed targets, of some recognized criteria across the country, which individual provincial governments could then interpret in their own terms and towards which they could design their own legislative programs in the light of their own priorities in the whole field of human welfare in their provinces.

It is target-setting, but here nothing can be imposed on the provinces; because we are talking about legislation for education which is, under our present constitution, unquestionably within provincial jurisdiction.

The Vice-Chairman: This may not be a fair question, but you referred earlier to the fact that the Atlantic Regional Development Authority was spending \$3 million on education. There are numerous other illustrations of that kind, and the federal Government is providing funds for education in all sorts of areas. I am wondering are we not inevitably heading into the position where a national office of education is almost inevitable? Regardless of what kind of machinery we set up to take charge of science policy for Canada, I don't think we can avoid complementary agencies to face the realities of the things that you are

talking about and that you are very politically—and I mean “politically” in the non-political sense—trying to achieve by consultation and exchange of ideas.

Mr. Goble: We are in favour, Mr. Chairman, of a Canadian office of education which would serve as an informational clearing house.

Senator Grosart: Except that we should call it the office of human resources.

The Vice-Chairman: That may be a good idea.

Mr. Goble: And, of course, one of the clearing house functions would be to correlate the work of various agencies of the Government of Canada in and around education. It would be more “around” than “in”.

Senator Yuzyk: Mr. Chairman, “science” today is a very fashionable word. Ever since we started our work in this committee we have noted that the meaning of the word “science” has become very extended. I remember in my day, when I went to school and to university, science was regarded as what today we term the physic sciences. The rest of what we talk about, and I went into that field, was the humanities. Today we have the physical sciences and we have the human sciences, or you may call them the natural sciences on the one hand and the behavioural sciences on the other. Science today is very confusing. The term “science” is confusing. How are we going to teach the pupils and the students what science really is?

Since this is the Canadian Teachers' Federation there must have been some thought given to the idea that there must be a redefinition of the word “science”. How would we define science today? We know that some of the scientists that we have called before our committee say that the social sciences are very important also in solving the great problems of society. Have you thought about the definition of science as it should be presented in the curricula of the provinces across Canada? It may be an unfair question at this stage, but I think we have to come to reality and have a clear definition of the word “science”.

Mr. Goble: I have given some thought to this, and it is glanced at in our brief although it was not developed because we have tried to keep this brief short and, hopefully, to the point. I don't know if I should make it clear

that what I am going to say is opinion and not organization policy. I will offer the opinion that I think science must be interpreted as the pursuit of ordered and structured knowledge of man and his environment, and an understanding of the causal factors operating on man and his environment. This of course could be expanded and, no doubt, leaves a lot of gaps, but I hope it suggests a broadening of the traditional interpretation of the word “science”. I think we are talking about man, where he stands in his world, how he relates to his world and how his world relates to him. I would like to draw your attention to page 3, paragraph 6 of the brief where this is glanced at.

A number of years ago, I think it was in 1919, Aldous Huxley picked up a point that had been made by his father, an eminent biologist, that it is important that there not be too great a gap between the scientist and the people, that the people comprehend the direction and drift and trend of the scientists and their purposes, because if they lost contact there would be the danger of a public rebellion against science and against the purposes of science which would result in a severe setback to human development. Part of the present rebellion of youth in our institutions is a rebellion against technology. This note is sounded more and more often, that humanity is being lost in the technological age. In fact as a classicist I deplore some of the vocabulary used. I think the word “technotonic” was used recently—a most horrible hybrid. This is the kind of thing we mean when we speak of the benefits accruing from a high level of education. It is important that there should be comprehension in the public mind of what is involved in science. It must be kept in mind that the goal of science is not simply improvement of industrial technology, but it is more and more interpreted in those terms by young people who find themselves disoriented and bewildered in today's world.

I think a necessary part of general science education, starting at the school level, must be this redefinition of the term “science” and a teaching of comprehension of the general purposes and goals of scientific exploration, of the origin of scientific curiosity in the human spirit—an attempt to restore integration to the learning process by blending knowledge of the discoveries of science with an understanding of the human aspirations of society.

Senator Grosart: You recognize the problem in your brief at page 6, headed "The Definition of 'Science'," where you use terms such as "science teacher," "science development," "science education," and so on. You are here using the term in a narrower sense. The difficulty is that the social sciences themselves are, most of the time, by the use of these phrases contributing to the narrowing of the term. This is a problem you recognize.

Mr. Goble: Yes, indeed.

The Vice-Chairman: Are there any other questions?

Senator Kinnear: Perhaps I might ask about your summary, page 2, (a), (b), and (c). In (c) you state:

That the present disparity between funds for research in the natural sciences and in the behavioural sciences be reduced.

I take it that research in the natural sciences is greater there, and you would like to have it evened up. Is that the way it works in that sentence?

Mr. Goble: Yes.

Senator Kinnear: Are you thinking of the behaviour of students in today's universities? Would you like more research done in that? I am not saying this lightly at all; I hope there is something being done about that in research.

Mr. Goble: We are more concerned with the behavioural sciences as the sciences which lead us to an understanding of the learning processes of children from their earliest years, on—just the business of understanding what goes on inside the mind of a child, what is the actual process of becoming aware, of memorizing, of understanding.

Senator Haig: Many parents would like to know that answer too.

Mr. Goble: Yes, indeed. This is the key to understanding behaviour in the broader sense in the adolescent, the young adult and the mature adult.

Senator Kinnear: They say the pattern is already established at age 3.

Mr. Goble: It is probably too late to find reasons for behaviour in the broad sense by studying those who are behaving; too late to find the reasons for the restlessness and the

rebelliousness of youth by studying rebellious and restless youth. We have to know how they got that way.

Senator Kinnear: Is there much work being done? We know all that, but are they coming to any conclusions?

Miss Channon: There are some studies being done at the University of Alberta into the views and values held by different types of students. Unfortunately, I think they have been concentrating more on the education students, who have been more conservative than others, but I think it would be possible to extend this study to other parts of the university. The results of this research will be quite interesting. I am positive it will be going on in other universities as well.

Senator Grosart: Mr. Chairman, the official definition by the National Science Foundation in the United States, which is, in effect, the official United States Government definition, specifically excludes from R&D all social sciences and psychology. I do not know why they add "and psychology" but they do. That is still the official definition.

Senator Carter: Do you know of any research being carried out, or recently completed, with respect to the education of handicapped children—the deaf, the dumb, the blind, and the mentally retarded?

Miss Channon: I could point to a series of studies that were done for the Hall-Dennis report. They are listed in the report, but I cannot give you the various names.

Senator Carter: Was that done in Canada?

Miss Channon: It was commissioned by the Hall-Dennis Commission.

Senator Belisle: What is the opinion of the Ontario Teachers' Federation of the Hall-Dennis report? Are they in favour of it?

Miss Channon: The Ontario Teachers' Federation in general would favour the forward-looking spirit of the report, and they are certainly working to see that their teachers give it great study. They have ordered sufficient copies so that each teacher has one. They have spent a lot of time studying the over 200 individual recommendations, and deciding how they are related to practice as it is now, and to their own policies that have been developed over the years. The evaluation of all that is presented in that report is very complex.

Mr. Goble: Sentiment generally is most favourable. There was a strong feeling that the report is an eloquent formulation of the aspirations that have been felt for a long time and towards which educational reform has been moving, so there is a general acceptance of it by teachers.

Miss Channon: But the grass roots level will say: "We have always been doing this".

Senator Grosart: Is there a fairly large hardware requirement for R&D in education?

Mr. Goble: It depends upon the depth. One of the most important areas of research into hardware for the learning process is being done, of course, by industry and in a rather alarmingly narrow way. The aim of industry is to develop a certain kind of device, and all of their effort is in the refining of that device, rather than being directed to the basic level of whether it is the device that is going to be, educationally, the most fruitful.

Miss Channon: I think there is an institution set up in the United States which is going to undertake to evaluate the usefulness and design of educational hardware. It is called EPIE, Educational Products Information Exchange.

Senator Grosart: There was an article in the *Saturday Review* quite recently on it.

The Vice-Chairman: If they get into the field of computerized instruction then they are going to get into expensive hardware.

Miss Channon: Yes, this is true. There is quite a debate in the States as to whether it is feasible to think about computers in the classroom.

Senator Grosart: Or television.

Senator Carter: Do you know of any research being carried out, or that has recently been completed, into the teaching of languages, the teaching of history and the effect of the teaching of history in different parts of our country, with the use of different texts?

Miss Channon: There is a study in history under way by the Ontario Institute for Studies in Education at the present time.

Mr. Goble: It is a little ironic that the only major study, of which I know, of the teaching of history in Canada, was developed locally within Ontario. It has been taken up by the Ontario Institute for Studies in Education and has now run up against the problem of

finding funds for its continuance as a project going beyond the borders of Ontario. There is no place to go except round and round the circuit of the foundations, mostly American foundations.

Miss Channon: I believe there was a study before that by the private schools.

Senator Carter: The Indians say we have misrepresented them and their culture in our books, that we are giving a false picture to our children of the part the Indians played in Canada. That is true of many other groups.

Mr. Goble: We ourselves are considering a study of text book references to our indigenous people to see if we can document this matter of disparaging, slighting references. The fear is that there is a process of unconscious, almost subliminal, education of the young. They develop attitudes towards these people through encountering these slighting references in books from their earliest years on.

Senator Yuzyk: Why just the indigenous people? Why not the various ethnic groups, about whom very slighting references are made in our history books? I have been reading some of these things, and I think it is lowering the standard of history when judgments are made by historians who really do not have all the facts.

Mr. Goble: In a way this is an easier problem to tackle, because the references are specific. Historians do make reference to the contribution of ethnic groups. The other would be harder to tackle because it is more insidious, with the use of words like "squaw" in a certain context, which has a disparaging tone. This sort of thing is dispersed through not only history books but story books and books of every kind.

Senator Yuzyk: How do you regard the Chilton method of teaching languages? I do not know whether you are aware of it. I have been reading about the Chilton method, which I think comes from Philadelphia. There is now a firm in Montreal developing the same techniques, I think in Canadian schools in various provinces.

Miss Channon: We had a seminar on teaching modern languages in 1962, at which we had several focuses. One was on the applied linguistic approach to teaching languages of any sort. In fact, this applies to teaching the native tongue as well as foreign tongues. The

techniques about which you are asking are usually variations of the direct teaching method wherein the teacher speaks in the language that is to be learned by the students. They do not teach the language by speaking English. They teach it by speaking the language being learned.

Senator Yuzyk: The audio visual method?

Miss Channon: That is part of it. The St. Cloud is another method.

Senator Yuzyk: Is that becoming more popular?

Miss Channon: I would think so.

Mr. Goble: It is becoming more popular. It is so much a matter of fashion in these things. The big problem of education research is generally evaluation. I mentioned the development of instruments of measurement being the point where you move out of the realm of speculative philosophy into the realm of science. We are very dissatisfied with the whole picture of the evaluation in Canadian education and feel this is one area where a concerted and general operation is required, a research operation across the whole country on a very large scale.

Miss Channon: In regard to the language question, research comes up with some rather devastating results. When you consider language laboratories of several years ago, it has been said that for the most part they are sitting in the basements of the institutions gathering dust. Some people are trying to find out how to use them. They have done some studies in the United States, particularly in the Keating Report in New York, which suggested that, using for evaluation language tests of various kinds, the achievement of lab and non-lab students was not very different. In criticizing the Keating report, there were put forward the other arguments that the teachers were not using the labs properly and that the labs did not have the right kind of feed-back procedure built into them.

Senator Yuzyk: Surely research work should be done in this field when we are paying so much attention to two official languages. We have other languages in Canada, and the teaching of languages becomes very important in the life of the student. Now, with French and the interest across the country in this language it will certainly be that if people want to learn French they will want to learn it as fast and as efficiently as possible. I

am not aware that we have developed techniques and methods that have improved the situation in the last 10 years.

Mr. Goble: Here is a beautifully illustrative problem, Mr. Chairman. You may say that the problem of bilingualism and of intercultural comprehension is vital to Canada. There is need for a Canadian institute for study of these problems and for development of solutions. Which of the Provinces will then say, "Very well, we embrace this Canadian problem as ours and will devote such and such a percentage of our overstrained and precious resources to setting up the institute that Canada needs."

Senator Grosart: Has not Quebec done that with the new Institute of Comparative Philology at Laval?

Mr. Goble: Yes, L'institut linguistique de l'U. té Laval has done work of tremendous value in language teaching.

Senator Bourget: I think somebody did recommend Quebec as the centre of excellence for education in languages.

Mr. Goble: You must consider all the dimensions of the problems—their different aspects in each province of Canada. How can you expect a province to devote its resources to embrace the Canadian problem as its own?

Senator Grosart: If you want to get federal funds, call it an econo-medgogi-model.

The Vice-Chairman: I believe you wanted to ask a question?

Senator Carter: I had one question, but it seems to have been answered.

The Vice-Chairman: Are there any other questions for our two panelists here?

Senator Carter: I would like to get their opinion on text books. Text books have always worried me. I have never been able to make up my mind whether or not they are a racket. They are sort of a necessary evil in a sense. I know they change much too rapidly, and the ones that replace the previous ones are not much better, but the change of text books cost the parents a tremendous outlay. What is the attitude of your foundation towards that?

Mr. Goble: I would comment on one aspect and Miss Channon may on another. The provision of textbooks in Canada is one of the

major problems in the sciences, particularly. We rely to a tremendous extent on American work in the development of curriculum, the sequence and development of specific texts. Beyond that, we have the problem of the lack of autonomy of the Canadian textbook publishers. Almost without exception, these are subsidiaries of American or British firms and their major source of material is the United States.

In the United States, I understand the mechanism for the production of textbooks is that the publishers look to the largest markets, and the present tendency is to look to the southwest, to California. Textbooks tend to be written to be acceptable to state authorities in areas of large population and large potential use. This means acceptance of certain political viewpoints and philosophical standpoints. But, to cover the situation where a textbook may not be accepted by the state authorities in the original target area—this is especially true in social studies, history, geography and so on—the textbooks are written with some care, so that they will not be objectionable to other states should they fail to obtain acceptance in the initial target area.

There are many specific problems in the various states, references that are taboo in one part of the country and not in another. Therefore the American textbook tends to end up as a lowest common denominator. Whether it is accepted or not in the United States, if it is economic to put money into it and have it printed and published, a Canadian edition is likely to appear, published by the Canadian subsidiary.

Since the publishing of textbooks is not a matter of prescribing the kind of textbooks to be published, because of the cost involved, but rather of choosing among those available on the market, this process to a great extent determines what books will appear in Canadian schools. It is not a very healthy situation.

Miss Channon: I was thinking of textbooks in the more speculative sense, as to whether we are going to have textbooks in the future as we have them now. There are a number of different things developing in different subjects, and I do not want to go into them all. I will take social studies as an example. There is a tendency towards going back to original source material as references, letting the course be shaped not by a particular textbook

but by the teacher's understanding of the subject at hand, and bringing in much enriched library resources for the students allowing them to work independently on projects related to social studies, so that the old image of a textbook being pursued page by page and day by day ought to vanish from the thinking of educators.

On the question of obsolescence of these materials, I think there is some work being done. This technological work is speculative in many cases, but we find ideas for retrieving from libraries of information related groups of films and paragraphs and so on, say by the cathode ray method or whatever method one happens to employ, or simply by the teletype machine typing back information on specific questions that may be asked individually by students. So the thinking is that you will not have textbooks in the future as we know them now.

Mr. Goble: In the meantime, the sad state of knowledge and preparation of science teachers in so many parts of this country produces a dependence on the textbook that is educationally most unhealthy and most undesirable.

Senator Belisle: May I add to this, that the sad state of our physical health will be the same if we do not adjourn shortly. We have been here since three o'clock.

The Vice-Chairman: I think that is right. I would like to just ask one question, because you will recall in some previous sessions the relevance of education was brought up and Mr. Goble referred to it earlier and I am wondering if it is his view that the university student activists are right when they say much of the education in universities today is irrelevant.

Mr. Goble: In my view, many of the things that are said by student activists are true. I hope you see in that the caution that I intend to put into it.

The Vice-Chairman: I think he is a politician.

Mr. Goble: Many of the comments on relevance are particularly justifiable.

The Vice-Chairman: Honourable senators, unless anyone has a very pressing question, I would like to thank the participants in this

discussion on your behalf and I would like to compliment you, sir, on the precision of your comments and to say that it has been an interesting session, particularly for the first day following the physical sciences. We are

now entering into the unexplored realm of the humanities and the social sciences, and the stratosphere looks to be the limit. Thank you very much.

The committee adjourned.

APPENDIX 98

BRIEF
TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
THE SENATE OF CANADA



HUMAN RESOURCES RESEARCH COUNCIL

EDMONTON, ALBERTA
MARCH, 1969

BRIEF
TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
THE SENATE OF CANADA

I. SUBMITTED BY: L. W. Downey, Director
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II. ABSTRACT:

1. There is, in our society and others, a growing assumption that only through the fullest development and most careful conservation of its human resources can any society hope to achieve greatness. When a society or a nation accepts that assumption as a matter of policy, it imposes upon its policy-makers and its institutions responsibilities and tasks which few, if any, are prepared to discharge. For they find, inevitably, that the fund of knowledge needed to implement the policy is too meagre. *What is needed, therefore, is a more vigorous and effective program of research designed to add to the store of relevant knowledge -- to inform the process of social policy-making as it relates to the development, deployment and conservation of human resources.*

2. Problems in the human or social domain tend to be multi-faceted; they tend not to be simply economic, or medical, or sociological, or educational, or what have you.

For that reason, the university, where research tends to be unidisciplinary and theory-based, is not the only or best locus for research in the area of human resources. *Instead, what seems to be needed is an independent, multidisciplinary, problem and policy-oriented research agency to study the complexities of human problems in modern society.*

3. Various departments of government (federal, provincial and municipal) have recently created research agencies to evaluate existing public services and to conduct inquiries into the unmet needs of society. But these research efforts have been seriously fragmented -- as a result of both intergovernmental and intragovernmental jurisdictional issues. Consequently, the researches have grown out of narrow conceptual designs and, hence, have yielded data which are, at best, inadequate, and in some cases, downright invalid. *What seems to be needed is a kind of quasi nongovernmental research agency, supported by government, responsive to the needs of government, but free to develop conceptual designs and research programs outside the constraints of traditional governmental structures.*

4. Conclusion: *Social science research agencies, existing outside governments but closely related to both governments and universities, have a unique and important role to play in informing social policy. They deserve the encouragement and financial support of all levels of government.*

III. ARGUMENT AND DETAILED RECOMMENDATIONS:

One of the strange paradoxes of modern life is the way in which the pace of physical resources development has tended to outstrip the pace of human resources development. One could (and many do) rationalize this paradox simply by pointing to the momentum that has been generated recently in the physical sciences and related technologies.

But it ought to be remembered that recent advances in science and technology have been made by *people*. A *few* people. People who were either attracted to this country or whose talents were developed in this country. And these few have somehow or other advanced the technologies of development and production to the point where the majority of our citizens can scarcely comprehend what is going on, let alone adjust to the transformations in life style, work patterns, and so on which these scientific and technological advances have spawned.

This situation cannot long endure. Either human resources development will accelerate to the pace of physical resources development or physical resources development will inevitably decelerate, accordingly.

RECOMMENDATION #1: THAT THIS NATION, THROUGH ITS GOVERNMENT, DECLARE ITS INTENTION TO GIVE PRIORITY IN THE DECADE AHEAD TO A SEARCH FOR THE MEANS TO THE FULLEST DEVELOPMENT AND MOST CAREFUL CONSERVATION OF ALL ITS HUMAN RESOURCES.

To adopt such a policy, however, is to pose for social policy-makers and certain institutions of society problems

which, in light of the present state of knowledge, virtually defy resolution. No longer, for example, will it be good enough for social agencies to treat second and third generation welfare cases with the traditional compensatory grants. No longer will it be good enough for gaols and mental hospitals to provide only custodial services. No longer will it be acceptable for schools to view the drop-out phenomenon as inevitable. And no longer will it be possible to tolerate the decay in the human environment which now is infesting most of our cities.

To deal with these and other problems rationally, and to anticipate other problems before they are upon us, it will be necessary to give some impetus (and perhaps, coordination) to on-going programs of research -- *evaluative research* to assess the effectiveness of existing programs and institutions; *stock-taking* or *descriptive research* to ascertain conditions and to establish bases against which to measure progress; *fundamental research* to fill gaps in knowledge; and *developmental activities* to bridge the gap between what is known and what is practiced in various fields of endeavor.

RECOMMENDATION #2: THAT, AS A MATTER OF NATIONAL SCIENCE POLICY, SOCIAL SCIENCE (HUMAN RESOURCES) RESEARCH PROGRAMS (AND AGENCIES) THROUGHOUT THE NATION BE VIEWED AS PARTS OF A TOTAL NATIONAL RESEARCH EFFORT AND BE SUPPORTED AS SUCH.

One of the persistent problems in policy-oriented, social science research (and, indeed, one of the reasons why the social sciences have not influenced social policy in the

same way as the physical sciences have influenced economic and physical resources policy) is fragmentation and duplication of effort.

In some cases, for example, we have federal, provincial and municipal research agencies charged with the collection and analysis of similar kinds of data; the only distinction in the mandates is the geographic area involved. In other cases, we have governmental, university and private agencies involved in the collection and analysis of similar, if not identical, data; the only point of difference is the specific question to be answered.

Clearly, if significant progress is ever to be made, duplication must be reduced and linkages must be established among all significant research agencies.

RECOMMENDATION #3: THAT THE FEDERAL GOVERNMENT COMMISSION AN INQUIRY INTO THE SOCIAL SCIENCE AND SOCIAL POLICY RESEARCH CAPABILITIES OF THE NATION WITH A VIEW TO ESTABLISHING GUIDELINES FOR GROWTH AND DEVELOPMENT, TO REDUCING DUPLICATION AND FRAGMENTATION, AND TO THE CREATION OF APPROPRIATE LINKAGES IN INFORMATION SYSTEMS.

Finally, it is suggested that some attention ought to be given to the question as to where social policy and development-inspired research ought to be conducted.

Traditionally, there have been two major alternatives: (1) university-based centres for policy studies; and (2) government-based evaluative research branches.

Experience has indicated that university-based research is likely to be theory-inspired (as opposed to policy or

problem-inspired); it is likely to be unidisciplinary (rather than multidisciplinary); and it is likely to terminate in data and conclusions (seldom in development and/or implementation activities).

Experience has also suggested that government-based research is likely to be evaluative (seldom predictive); it is likely to be problem-based (accepting policy as given); and, hence, it is likely to lead only to incremental changes (seldom to major reform) in existing practice.

Admittedly, these generalizations do not *always* hold. The evidence has been sufficiently compelling, however, that in many instances, governments have turned to what has been called "quasi-nongovernmental agencies" for leadership in the conduct of mission-oriented or policy-based research. For it has been found that, freed of the traditions of the university and the constraints of government, certain kinds of research activities tend to flourish.

RECOMMENDATION #4: THAT THE GOVERNMENT OF CANADA ENCOURAGE THE CREATION AND DEVELOPMENT OF REGIONAL OR PROVINCIAL, SOCIAL POLICY RESEARCH AND DEVELOPMENT AGENCIES AND THAT THESE BE EXPECTED TO CONDUCT SUCH REGIONAL RESEARCHES AS MAY BE REQUIRED TO INFORM NOT ONLY LOCAL AND PROVINCIAL POLICY, BUT ALSO NATIONAL POLICY.

APPENDIX 99

BRIEF

SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

by the

CANADIAN TEACHERS' FEDERATION

OTTAWA
APRIL 1, 1969

Special CommitteeBRIEFSUBMITTED TOTHE SENATE SPECIAL COMMITTEE ON SCIENCE POLICYby theCANADIAN TEACHERS' FEDERATIONSUMMARY

1. The Canadian Teachers' Federation submits that a science policy for Canada should take account of the vital role of science education in the advancement of science. Recognizing the problem of reconciling national needs with the exclusive jurisdiction of the provinces in education, we urge that the solution be sought through adoption of the following principles:

- a) Consultation with the provincial governments, which have jurisdiction over education, in order to make mutually acceptable arrangements, and
- b) The placing of necessary funds in the hands of the competent educational authorities in cases where the fiscal resources of the province concerned are demonstrably inadequate.

2. To meet the responsibility of the federal Government in these matters, and to remedy the present serious deficiency in Canadian resources, we recommend the following measures:

- a) A national advisory body should be established to identify and define Canadian needs, and establish Canadian policy guidelines, in science education. It should include representatives of provincial governments, the teaching profession, universities, the scientific professions, industry, and appropriate departments of the Government of Canada.
- b) A permanent planning committee should be established to devise means of ensuring that provincial educational provisions in the aggregate meet the national needs, and that the resources of the provinces are supplemented as necessary to achieve this end. Membership on this

Summary of Brief (continued)

committee should include the provincial ministers of education, appropriate Ministers of the Government of Canada, the universities, representatives of the teaching profession and representatives of the scientific professions.

3. It has been customary to restrict the term "science" to the natural sciences. We believe that, in the national interest, the behavioral sciences must be included in the development of an overall science policy, and that the need for research in education must be seen as a high priority in that field. There is an urgent need for governments at all levels to work together to ensure that constitutional barriers do not inhibit the growth of essential services.

Accordingly, we recommend:

- a) That any general science policy developed include the behavioral as well as the natural sciences.
- b) That research in education be unequivocally recognized as a part of behavioral science research in general.
- c) That the present disparity between funds for research in the natural sciences and in the behavioral sciences be reduced.
- d) That federal funds for research in education be made available on a large scale to the appropriate authorities (through contractual or other arrangements).
- e) That the federal Government support the development of a Canadian system for rapid dissemination of research information.
- f) That the federal Government promote and help finance regional centres for research and development in education.

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BriefSubmitted toThe Senate Special Committee on Science Policyby theCanadian Teachers' Federation

1. The Canadian Teachers' Federation is pleased to have this opportunity to present its views to the special Senate Committee on Science Policy. CTF acts as the national and international spokesman for associations of elementary and secondary teachers in all the provinces and territories of Canada; the combined teacher membership is 185,000. As a professional organization, CTF is concerned with the general improvement of education, particularly through increasing the skill and competence of teachers. To this end it has undertaken vigorous programs of professional development both in Canada and in less privileged countries abroad.
2. In addition, CTF, while recognizing provincial jurisdiction over education, is committed to the view that there are national purposes which may be advanced only through improved education. In the present instance, for example, we consider the advancement of science in Canada to be inextricably linked with improvements in science education. Consequently, it is our view that means must be found by which (a) co-operation in planning among the federal Government, leaders in various spheres of business and academic activity, and the provincial authorities responsible for education may be promoted and (b) federal financial resources may be allocated to the responsible authorities. It seems only logical that national planning, action and funds should be devoted to the advancement of national purposes.
3. As a general approach to the advancement of science in Canada, CTF supports the establishment of rational guidelines for development, the implementation of a vigorous program of research in the pure and

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applied sciences, and increased cooperation among all the agencies involved.* All of these measures are vital to the economic welfare of Canada. However, there are two aspects of science policy which CTF wishes in particular to bring to the attention of the Committee. One has already been mentioned -- the necessity of taking into account the vital role of science education in the advancement of science. The other is the question of what spheres of knowledge are to be defined as sciences.

Science and Education in the Natural Sciences

4. The level of scientific competence in any society depends on the quality of its educational institutions. There are three reasons for this. First, scientific advance must depend, to a great extent, on the research capacity of universities. This is not merely a matter of providing research opportunities for eminent scholars. The involvement of students is essential, both to the performance of the complex tasks associated with research projects and to the maintenance and increase of the supply of future independent researchers. A university that lacks teaching facilities, or is deficient in its teaching function, cannot long continue to be an effective research centre.

5. Secondly, the foundation for all specialized scholarship is laid in early learning, both general and specialized, in the schools. The quality of the educational process from kindergarten on determines the size of the eventual pool of potential scholars in all disciplines. In particular the nature of the educational experience in the schools will

*That cooperation is needed has been amply demonstrated by the duplication and confusion (particularly in the disbursement of funds and the assignment of general areas of program activity) that results from the independent operation of bodies such as the National Research Council, the Canada Council and the Defence Research Board.

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to a great extent determine the number of future scientists. As we have earlier indicated, it is our conviction that the quality of educational experience depends, in turn, on the level of skill and competence of the teacher. Without an adequate supply of well-prepared teachers at the school level, the production of an adequate number of competent scientists is impossible. (It is relevant, at this point, to draw attention to the heavy dependence on immigration to maintain the supply of specialists in the physical sciences in Canada.)

6. Thirdly, an adequate level of general scientific education is necessary to produce a sufficiently well-informed citizen body. Quite apart from the general benefits accruing from a high level of universal education, it is important that there be a general comprehension in the public mind, of the need for investment in scientific research.

7. It has been argued above that scientific development depends on a higher level of education in the natural sciences. If this view is accepted, then the problem arises of reconciling Canada-wide needs with the exclusive rights of the provinces in regard to education. Since this problem arises whenever national purposes which overlap with educational purposes are identified, it is the view of the Canadian Teachers' Federation that the federal Government should adopt the following general procedures for dealing with the problem:

- a) Consultation with the provincial governments, which have jurisdiction over education, in order to make mutually acceptable arrangements, and
- b) The placing of necessary funds in the hands of the competent educational authorities in cases where the fiscal resources of the province concerned are demonstrably inadequate.

8. The procedures outlined above may serve as a general guide to meeting the more specific problems in science education. In order to assess these specific needs, we have consulted with the Canadian Association of Science Teachers, a specialist organization associated

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with the Canadian Teachers' Federation. Our colleagues in this association point out that there is an extreme shortage of well-qualified science teachers at all levels, and that obsolescence of knowledge is becoming a crucial problem even for those teachers whose initial qualifications were adequate. Science education in Canada is suffering grievously from the lack of funds and facilities for the continuing education of teachers. Canadian teachers (particularly at the school level) are dependent to a deplorable degree on the resources and generosity of the United States, particularly as extended through the National Science Foundation and the National Council of Teachers of Science. While this generosity is acceptable, it should not indefinitely substitute for the development of Canadian facilities.

9. To fulfil the responsibility of the federal Government in these matters, and to remedy the present serious deficiency in Canadian resources, the following measures are recommended:

- a) A national advisory body should be established to identify and define Canadian needs, and establish Canadian policy guidelines, in science education. It should include representatives of provincial governments, the teaching profession, universities, the scientific professions, industry, and appropriate departments of the Government of Canada.
- b) A permanent planning committee should be established to devise means of ensuring that provincial educational provisions in the aggregate meet the national needs, and that the resources of the provinces are supplemented as necessary to achieve this end. Membership on this committee should include the provincial ministers of education, appropriate ministers of the Government of Canada, the universities, representatives of the teaching profession and representatives of the scientific professions.

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The kinds of specific activities for which the committee might plan should include the following:

- (i) The establishment of regional curriculum centres for the development of science curricula at the elementary and secondary level. (The objective of these centres would not be to establish a unified curriculum, but to develop consistent and educationally sound guidelines at the level of conceptual scheme, concept, and sub-concept.)
 - (ii) The sponsoring of summer seminars conducted by leading scientists and researchers as an aid in the professional development of teachers.
 - (iii) The provision of adequate programs in the universities to enable teachers, either through sequential summer courses or through full academic term courses, to pursue their studies to the doctoral level.
 - (iv) The promotion of communication and cooperation between educational authorities and industry to ensure that education continues to meet changing needs.
 - (v) The encouragement of continuing exchange of educational ideas and information and the stimulation of interest in science education. (This might be accomplished through direct support to organizations such as the Youth Science Foundation, and through promoting and financing programs of student and teacher exchange and educational tours.)
- c) An agency of the Government of Canada should be established either as a branch of a federal department or as a Crown Corporation, to be the major administrative instrument for federal Government participation in the programs outlined above. It should have sufficient funds at its disposal to meet the obligations proposed, and full authority to assign

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these funds through grants, scholarships, loans or in any other manner acceptable to the proposed planning committee.

The Definition of Science

10. It has been customary to restrict the term "science" to the natural sciences, and indeed, this more limited definition has been applied in the earlier part of this brief. However, it may be strongly argued that the behavioral sciences are, as their name implies, part of science in general and should therefore not be omitted in the development of an overall science policy. The claim of the disciplines concerned with behaviour to recognition as sciences arises not only from the nature of research and theory development in these fields, or from their appeal to empirical data, but also from the appearance in recent years of new disciplines which refer themselves to the models of both natural and behavioral sciences.

11. It has not only been customary to exclude the behavioral sciences from the mainstream of science. It has also been customary to exclude education from the behavioral sciences. In part, this treatment has resulted from a failure on the part of education to arrive at its own definition. In fact, there is currently a lively debate as to the exact status of education in the world of disciplines. One author describes education as "a great interdisciplinary nexus."¹ Another advances the opinion that it is to be regarded as an applied behavioral science.² Still another puts forth convincing arguments to the effect that education is a discrete discipline in its own right.³

¹Macdonald, John. The Discernible Teacher (Ottawa: CTF, 1968), p. 41

²Stiles, Lindley J. "Education: An Applied Behavioral Science", Journal of Educational Research 61:1, February 1968.

³Belth, Marc. Education as a Discipline (Boston: Allyn and Bacon, 1965).

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12. Whatever the outcome of this debate, it is quite clear that in many of its aspects education ought to be regarded as a science of behaviour. Educational research, in particular, is one of these aspects. As is pointed out in the Encyclopedia of Educational Research, "The formal nature of the knowledge obtained in the science of education is not essentially different from that of other scientific fields."⁴

13. Educational research both draws from the behavioral sciences and contributes to them. Thus it seems inexcusable that it should be kept away from the source of funds devoted to the behavioral sciences. The absurdity becomes more apparent when one notes that funds are available for the study of the learning patterns of rats, pigeons and guinea pigs, but not for the study of the learning patterns of children in school classrooms.

14. This is not to suggest that funds for the behavioral sciences in general are particularly ample. By comparison with the amounts spent on research in the natural sciences, the amount spent on research in the behavioral sciences is almost negligible. And yet it would plainly be in the interests of Canadian society to devote a greater proportion of its resources to research in the behavioral sciences -- particularly educational research. The Economic Council of Canada, for example, has on a number of occasions pointed out the need for great improvements in education. It seems unlikely that this can be accomplished unless it is made possible for research to become a vital force in this improvement.

15. The Canadian Teachers' Federation is of the view that the creation of a science policy which covers both the natural and the behavioral sciences would help to remedy the disparity in financial support which currently exists between them. It therefore recommends that this definition of science be adopted in the formation of such policy.

⁴Monroe, Walter S. (ed.) Encyclopedia of Educational Research (2d ed's New York: Macmillan, 1950), p. 1147.

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16. Under a broad science policy of this nature, certain special problems in the area of educational research might then be considered. The two most pressing needs in educational research at present, apart from the need for a general influx of funds, are (a) more research and development centres and (b) communication systems for disseminating research results.

17. Research and development centres are needed so that projects may be designed which will take research studies out of the unreal and sterile conditions of the laboratory and into areas where the many complex variables in actual learning situations may be observed and assessed. The magnitude of the research involved, however, is such as to put it beyond the financial reach of many of the provinces. Thus federal support for the institution of regional centres of this type is very necessary.

18. Lack of funds has also prevented the development of a Canadian counterpart for ERIC (Educational Resources Information Centre). ERIC provides for the United States a unique system for the collection, storage and dissemination of information on current research and development in education. It might be argued that it would be more economical for Canadian researchers to tie in with the ERIC system. On further reflection, however, this solution does not seem adequate. In the first place, the priorities established by the ERIC Clearinghouses for collecting and storing information are not always consonant with those which would be established in Canada. Moreover, ERIC functions only in English, whereas a Canadian system would be able to provide services in both English and French. It seems unlikely that an information system of this type can be established in Canada without financial assistance from the federal Government.

19. In making these recommendations in regard to educational research, the Canadian Teachers' Federation does not dispute that the right to legislate in educational matters is reserved, by the Canadian constitution,

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to the provincial jurisdictions. However, it does suggest that there are national needs to be met and that educational research and communication questions transcend provincial borders. Thus there is an urgent need for governments at all levels to work together to ensure that constitutional barriers do not inhibit the growth of essential institutions. The particular role that the federal Government should play in this area is summarized in the following recommendations:

- a) That any general science policy developed include the behavioral as well as the natural sciences.
- b) That research in education be unequivocally recognized as a part of behavioral science research in general.
- c) That the present disparity between funds for research in the natural sciences and in the behavioral sciences be reduced.
- d) That federal funds for research in education be made available on a large scale to the appropriate authorities (through contractual or other arrangements).
- e) That the federal Government support the development of a Canadian system for rapid dissemination of research information.
- f) That the federal Government promote and help finance regional centres for research and development in education.

APPENDIX 100

SUBMISSION OF BRIEF

TO

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

BY

THE CANADIAN COUNCIL FOR RESEARCH IN EDUCATION

Special Committee

Submission to the Special Committee on Science Policy

of the Senate of Canada by

The Canadian Council for Research in Education

Summary of Proposals contained in the following brief:

1. That the Federal Government increase its contribution to scientific investigation within the field of education in those areas on which agreement can be reached with the Council of Ministers of Education, and in ways which will ensure the wise expenditure of allocated funds. It is suggested that one per cent of the total expenditure on education be allocated for research and development, and that the Federal Government contribute half of that amount, (estimated expenditure on education for 1968-69 was \$5,931 million, one-half of one per cent of that is just under \$30,000,000).

2. The following would seem to be suitable areas for Federal contribution which would not infringe on provincial control of formal education within provincial territory.

- (1) The undertaking of basic research in the field of cognitive, emotional and motor behavior related to learning, memory and such;
- (2) The development and most effective use of modern media (hardware and software) including computer assisted instruction, television, films, etc.;
- (3) The utilization of modern communication devices in education and training;
- (4) R & D in vocational-technical education and training, community colleges and other institutions;
- (5) R & D concerning disadvantaged youth, and compensatory education;
- (6) Grants for R & D in education. These could be made available to universities and colleges or could be administered by some unit or association such as CCRE which is broadly based enough to ensure stability and efficiency and be strictly impartial.
- (7) Financial support for a comprehensive survey of the establishment of R & D in Canada, personnel, finances, etc.

CCRE and CERA/ACCE

As no group in Canada has produced a comprehensive policy for research and development in education for Canada, it is impossible to provide a definitive statement which has been generally approved. CCRE expects to take steps to change this situation within the current year. Although we have not had an opportunity to check with the Canadian Educational Researchers Association, provincial research councils, or for that matter with the members of CCRE, it is hoped that this brief is representative of the thinking of most researchers and developers in the field. There is essentially nothing in it which has not already been in print.

The Canadian Council for Research in Education was established in 1961 as successor to the National Advisory Committee on Educational Research, which had been organized on a voluntary basis by national education associations to stretch limited resources through consultation and eliminate much duplication of efforts. More positively, CCRE aims to stimulate, promote, maintain and generally improve the quality of Research and Development in Education throughout Canada. To this end it promotes public awareness through meetings, conferences, publications, and otherwise stimulates communication and the voluntary coordination of effort among producers and consumers of research. It issues the Bulletin, the Canadian Education Index and such other publications as time and resources permit, and holds meetings and conferences to meet identified needs. As a cooperative venture, its present membership consists of representatives from most national, professional, education associations,

the ten Departments of Education and the provincial research councils as full members; with some government departments and other education bodies as associate members. At its 1968 Annual Meeting the membership agreed to invite faculties of education, larger school boards, industrial firms and other organizations interested in education, to apply for membership. It has since grown and can be expected to grow in numbers and stature.

Since CCRE is basically an association of organizations, it cooperated in the establishment of CERA/ACCE (The Canadian Educational Researchers Association/L'Association canadienne des chercheurs en éducation), a society of individual professional researchers concerned with the needs and interests of those engaged in research and related activity. CERA/ACCE plans to hold colloquia, seminars and special projects, provide for inter-university training projects, set up a directory of research personnel and resources, issue a newsletter and such. CERA cooperates with CCRE in holding an annual conference. It is expected that this organization will carve out an enviable role for itself as the research force grows.

The Research Enterprise in Education

A vast research and development education burst, as a reflection of public policy and supported by public funds, mostly federal, has been evident in the United States during the Sixties, with somewhat similar advances observable in many other progressive countries. During the next decade these may jolt the educational research community and, in fact, the whole of formal education. From a desultory avocation where such research endeavour as was undertaken was generally instigated at the whim and caprice of the dilettante, or the dedicated scholar on his own time, the research community moved to become something of a rat race in areas where "publish or perish" provided an incentive. In the U.S.A., research has now become a monumental enterprise with \$100 million annual federal support and with the bulk of the research being undertaken outside the faculties of education. It is emerging as a social process of broad scientific and social concern, with approval of design, processing and evaluation necessary before projects are approved and funded.

In Canada there is some evidence that research will become a serious economic activity; but until much greater funds are available the situation will at best remain confused. In the meantime, Canadian researchers and others interested in research endeavour need to concern themselves with formulating models to ensure that even such limited resources as will be available for some years at least will be wisely used.

The Canadian Council for Research in Education, in respectfully submitting the following information for the serious consideration of the Special Committee on Science Policy, is fully cognizant of certain economic, social and political difficulties, and of honest differences of opinion not only among the ranks of educators, but other disciplines as well. It assumes, however, that with men of good will none of these roadblocks are insurmountable, but that compelling reasons of necessity not only warrant this submission, but add a certain urgency to the need for finding a solution if Canada's world position and internal well-being are to be assured.

In recommending that there be provision for systematic planning and R & D in the field of education, CCRE recognized that to some, education is an art, and therefore lies outside the frame of reference of your Committee; and that others are equally positive that we should be bending all of our efforts to develop a complete science of education using experiments, the systems approach and educational technology. The position adopted here is middle ground. CCRE recognized that scientific activities in education are the best means of ensuring planned orderly advance and of bridging the gap successfully between the education that is and the education that is needed to meet demands by the individual and by society today. Most educationists agree that the scientific method can be harnessed to improve curricula, speed up mastery of subject matter, and ensure good organization and orderly advance. The possibility that we may fail in the expansion and restructuring of education, even to the point of crippling the future of our society is by no means negligible.

At the same time, CCRE wishes to make clear that its recommendations in no way are intended to usurp any of the powers and authority that provincial departments of education are exercising at the present time. Decision making concerning the education systems by the provincial authorities is accepted as a working hypothesis by CCRE -- whose main objective is to work with the provincial departments and others for the good of the education community, the individual and society. Within the present framework it would appear that R & D can be integrated into school systems, that basic and product research can be conducted by universities, institutes, government departments or private industry, and some development projects can be carried on as interdisciplinary efforts, cooperative endeavour or otherwise. Basic and product research would appear as legitimate fields for the Federal Government, private industry and for various faculties of the universities.

Advance without R & D and planning is blind and hazardous. Education without scientific assessment could be a will-of-the-wisp with changes being introduced by whim, caprice and common sense. Through adopting the scientific method, harnessed in planning, research and development, which has already given some evidence of its potential, we should be able to introduce change with much less risk of misadventure and of waste.

Educators are concerned generally with providing education designed to develop the individual in all ways according to his potential and our social values and assume this is for the good of society. They feel it would be a mistake to consider only the economic aspects of society but equally wrong to neglect them. They are concerned with achieving objectives, aims which are accepted and approved by the community at large, but which may have been proposed by members of the academic community, the Department of Education, or others interested in education. The R & D personnel may convert these into behavioral working units and try to discover how well various subject matter and methods can contribute to attainment of these goals. None of this abrogates decision making which is the prerogative of administration. It may, however, contribute objective data to supplement economic considerations, social climate and such in evaluating the situation, and to give confidence to those who take the decisions.

The Interprovincial Conference on Education

At the Interprovincial Conference on Education, Montreal, 1966, of the briefs submitted relating to educational research and development needs and opportunities, none questioned the need for change in education nor suggested that already we had machinery adequate to deal with present education problems, or felt confident that they could go beyond recommending possible approaches or innovations which should be subjected to experiment and field trial. Most of the briefs contained criticisms, either spelled out or implied, of the current systems. They suggested that present shortcomings were due largely to changing conditions; resulted from a lack of machinery to forestall imbalance and test and introduce innovations; or they deplored the usual lag between recognizing needs and finding solutions.

Criticisms included suggestions that our education system was geared to an agrarian economy or Elizabethan society; that our secondary education was a feeder system to university, although less than fifteen per cent continued in school that long; that our vocational-technical courses were too often related to a static employment picture, sometimes preparing youth for moribund occupations while they live in a scientifically-affected, industrialized society where increasing numbers are employed in the public and private service sectors. All of the briefs recommended more planning, more research, more development activity, and more evaluation. Perhaps the important thing about them was the lack of satisfaction with the status quo and the acceptance of need and urgency for change.

Some Economic Aspects of the Issue

Three trends -- a demand for greater educational opportunities, a growing acceptance of the need for longer schooling, and increasing enrolments from high post-war population birth rates -- have resulted in a high ratio of school population to the work force at a time when capital costs and wage rates are rising. At the same time the struggle for world markets; a desire to increase the level of living for all citizens; rapid technological expansion, in part due to the computer, space exploration, etc.; and the mushrooming knowledge explosion have all focussed attention on education as never before. It has become trite to remark that we are in an era of rapid change and the most we can hope to do is prepare for change.

With the expenditure on education rising to absorb nine per cent of the Gross National Product, economists have increased their concern with the role and efficiency of the education enterprise. They have singled out education as one of the important factors for economic advance about which something can be done. They have also shown that returns on investment through education in human capital are high, both to the individual and to society. Education is not only a basic source of past and prospective economic growth, but it is an element most amenable to conscious social decision. An interest in the product of the schools has become of vital importance to government at all levels, to all employers and to those seeking employment.

More particularly economists have increased their interest in education for such reasons as the following: the mammoth expansion in education structures and rising costs of education; shortages of professionals but particularly of engineers, technicians and skilled workers; increased concern with economic growth and foreign trade; an increasing fund of knowledge, rising expectations of entrants to most positions, and the elimination of unskilled trades; the importance of helping minorities, disadvantaged and atypical children; the use of manpower forecasting; and an interest in the contribution of education to lifetime earnings and to the economy. Most of these point to areas where research and development should be undertaken. The economic studies to date are highly indicative but must be considered as pilot projects.

Schools must be run efficiently and with an economically sound policy. Those undertaking R & D in education as in industry can be expected to assure the public that through R & D the schools system can be improved so that pupils will achieve the same amount in less time, achieve more in the same time, cut down waste and losses or otherwise increase efficiency. Educators would wish to achieve this through doing more for each and all.

There is some argument as to how this is to be done. Systems analysts, developers of automated education devices, promoters of the newer media and researchers offer a variety of solutions. With large corporations merging to produce both hardware and software for the schools, there is need for independent research centres, institutes, or other staffs to test all of these and to discover how and when to use each gadget, and when not to install it.

Costs affect R & D directly in that it is now known that a great deal of approved R & D, including basic and product research, runs into big money because of personnel involved in planning, administering and processing data, the use of computer time, the need for relatively large samples and a field task force, and the necessity of continuing the research for an appreciable time. The same is true of large development projects in which research may contribute to the sampling, design, preparing of instruments, processing and assessment. Where such research and development projects are undertaken there are problems of funding, grantmanship and control. Without assurance that the project to be undertaken has a reasonable chance of success and deals with an important issue, money is seldom forthcoming.

The Social Side of the Issue

Although emphasis has understandably been greater on the economic than the social aspects of understanding in education, the evidence of social unrest is now such that greater efforts must perforce be directed towards a fuller appreciation of what is going on, and the role education might play in getting back on an even keel. Sociologists are increasing their participation and bringing to bear their techniques for discovery on the education picture, but since it is more difficult to document social than economic change in numerical terms, and there is greater interest in the economic, at least by the older generations, there is need for a concerted effort to promote systematic endeavour concerning the social aspects. In some way interests of the sociologists come closer to those of educators, although the latter put greater stress on individual differences and the psychological aspects of teaching and learning.

Education has always been considered by political leaders as a vital instrument in the rearing of "good" citizens, and they have generally been at pains to keep control of the education system. R & D can be directed towards increasing understanding and giving direction to ensure good citizenship

so as to achieve the aims of society and have our democracy operate effectively. The current unrest of students, teachers, parents and others in education would point to the urgent need for research units in a position to offer solutions when time is short, if we are to avoid catastrophe.

We are living in an age of cultural as well as economic, social and political upheaval, an age in which our value system is hardly identifiable, in part because we find a melange of new and old value systems. Educators are leaving their cloistered walls and sheltered classrooms in the hopes of achieving increased understanding of the changing world, society and themselves, and becoming actively engaged and effecting a new role for education in all this. Always a mirror of the society which shapes them, though generally in operation behind the front lines, the schools nevertheless have the potential to operate directly and indirectly towards shaping tomorrow's society.

We are becoming more interested in evaluating and increasing the effectiveness of educational methodology to promote an intellectual appreciation and assessment of world conditions by today's youth. It is becoming harder day by day to ignore the problems of those living beyond our communities and those in our communities who fail to benefit from an affluent society. Strategic education policy must, among other considerations, meet the needs of the individual, the demands for trained manpower, and other needs of society. Fortunately these are not mutually exclusive and differences can be ironed out although there is great need for compromise and much more evaluation. Those planning education are becoming increasingly concerned with both quality and quantity. The trouble is that there is so little comprehensive systematic planning being attempted and a shortage of those qualified to undertake it.

A Balanced Program of R & D

In CCRE publications the need for a balanced program for R & D has been stressed. This sets out that there must be provision for basic, applied, institutional, service and other research endeavour.

Basic research is aimed at the production of knowledge about the way in which human behavior is modified through interaction with the physical and social environment. It is exploratory or theory related. Applied research concerns itself with either the possible effective application of basic research to normal education situations or the seeking of solutions to field induced problems. Institutional research is concerned with program and related problems and is generally developmental. Service research is concerned with communication, establishing data banks, action research, etc.

Making such distinction, even though all categories may not be mutually exclusive in all situations, is practical from considerations of the allocation of funds, education control, and program evaluation.

Applied and product research and development can normally be expected to produce relatively quick and measurable returns. Long term returns, however, are essentially dependent on basic research which is expensive, as in the natural sciences, except that here the variables are even more difficult to control.

A balanced program should ensure that emphasis falls on all segments and that none are neglected. It should minimize fads and band-wagon interest in selected areas. It will most probably require justification for the allocation of funds for worthy projects with provision for development phases and evaluation. It will ensure short-term beneficial results from school unit research and long-term benefits from break-throughs at the basic research level having application for the schools.

Neither Canada, nor for that matter any of the provinces have a comprehensive policy for R & D in education, nor are there sizable funds allocated for grants for such research. Four provinces have fairly recently added Institutes, all unique, and their influence is now being felt, and there are government grants available for approved vocational-technical research projects and a few for other studies. The situation, nevertheless, for researchers in the field of education is rather barren and there are many projects either in the planning stage, or beyond the pilot study stage, at a standstill for lack of funds. If Canada is to compete on equal terms among advanced

countries and hold its skilled manpower, this situation must be changed. CCRE and others have suggested that a modest one per cent of the total spent on education be allocated for R & D. By no calculations can an amount equal to half or even a quarter of that be discovered at present -- a situation which would be most unacceptable in industry where from three to fifteen per cent is normal and considered necessary to keep ahead.

There will be change in education. The alternatives for introducing changes are (1) trial and chance success under an evolutionary, laissez-faire approach which provides for unsystematic, reactive series of changes; (2) changes effected through copying others; or (3) planned and tested change. In a multimillion dollar enterprise (just under \$6,000,000,000 in 1968-69) it appears surprising that any one would settle for less than adequate planning, the field testing of inventive solutions with high probability of success, and objective evaluation.

The Funding of Research and Development in Education

The costs of providing formal education have been rising rapidly for some two decades and have reached an all-time high of something more than an estimated \$5,931,000,000 in 1968-69 of which some 64 per cent goes for elementary-secondary and 24.5 per cent for higher education. The 11.5 per cent for other education can be expected to rise rapidly because of the demand for post-school education. Capital outlay to provide additional places was first felt at the elementary, then the secondary and now at the higher education level. At the same time there was rapid expansion of trade and technical schools and more recently a mushrooming at the community college level. Not only has there been a sharp increase in capital outlay but this came at a time when construction costs were increasing sharply. Cost of equipping the new structures has also shown a rapid rise in part due to inflationary tendencies, but also due to the introducing of new equipment, such as computers and newer media of instruction. Salaries and wages have also risen. Yet it has been difficult to obtain sizable amounts for R & D in education with a few notable exceptions. As a result, whereas figures for the United States indicate that one-half of one per cent of the total spent on education is allocated to R & D, Canada falls far below that and below estimates for many progressive European countries.

There is a shortage of qualified professional personnel to undertake R & D. Today many positions are vacant or being filled by new immigrants to Canada, members of other disciplines, or some with relatively low qualifications. CCRE has recommended that a comprehensive survey be undertaken to provide answers to questions concerning the need for R & D personnel, qualifications of those now undertaking such research, capacity of the present establishment to prepare competent personnel and money used for R & D. An estimate of needed personnel in this area by CCRE showed that there would be openings for 5,000 researchers and developers (inclusive of professionals doing research part time) by 1975.

As total personal income varies rather widely from province to province with costs rising, some will feel the pinch more than others. If some degree of parity is to be reached in the ability of provinces to provide research and development centres then federal funds must be used to provide equalization grants. There are various ways in which this could be done; the exact method would have to be worked out by the governments concerned.

There are legitimate areas in which Federal departments of government could well undertake product and communication research, basic research, and research for its wards, the Indians and Eskimos.

(1) Contributions of the Federal Government

The Federal Government has already attested to its interest in the educational output through grants to higher education, vocational-technical education and research in many areas. Federal contributions to R & D in education could well be increased for the following:

- (a) Grants for approved projects in basic research which may be undertaken by Government Departments, faculty members of universities or institutes, associations or individuals, and be administered through Federal Departments, associations such as CCRE, university faculties or institutes.

- (b) Grants to provincial departments for research on a sharing basis. These could be based on population, education faculty enrolment or other easily administered yet reasonably equitable basis.
- (c) Building grants for institutions, research and development centres, data processing units, etc.
- (d) Research grants for research projects in vocational-technical, community college and other post-secondary projects.
- (e) The establishment of a Social Science Research Centre or Human Resources Council inclusive of education which could function as a Crown Corporation.
- (f) Data collection agencies, data banks, communication systems for R & D findings, etc. Forecasting and planning bureaus.

These are in addition to provisions aimed at the equalization of ability to conduct R & D, to test innovations and to provide for evaluation.

(2) The Provincial Governments pursuing current policy would accept responsibility for providing:

- (a) Institutes of education, research and development centres or the equivalent.
- (b) Grants for research by qualified professionals. It is assumed that the province will make provision for all sorts of research, basic, applied, institutional, service, etc., although the local units will be essentially responsible for the institutional R & D.
- (c) Grants to school boards to assist them in establishing R & D units.
- (d) Support for provincial research councils or other worthy associations.

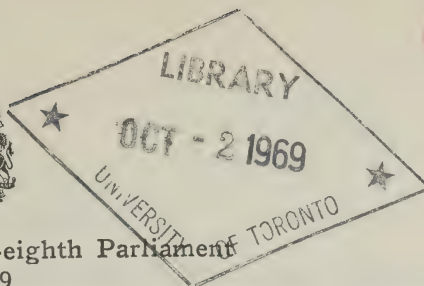
(3) School Boards, Universities, Community Colleges and such Institutions could provide for institutional research and development units for program and other endeavour.

(4) Foundations can increase grants in support of research projects of all sorts whether to associations or individuals.

(5) Business and Industry have vested interests in research and development because of the product and some enterprises are concerned with producing aids for education. They could well make greater investments as:

- (a) Grants for product, applied and other research projects;
- (b) Grants to research associations;
- (c) Other grants to universities and institutes.

The task force of the Interprovincial Conference on Education recommended that the Federal Government contribute half of the expenditure on R & D in Education. They noted that one per cent of the total in 1964-65 would have been 32.8 million or a contribution of 16.4 million for the Federal Government. Today it would be closer to \$30 million.



First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS OF THE SPECIAL COMMITTEE ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 52

WEDNESDAY, JUNE 4, 1969

WITNESSES:

Biological Council of Canada: Dr. James F. Stevenson, President, Dr. K. C. Fisher, Commissioner, Survey of Biology, Science Secretariat; Dr. W. H. Cook, Past President, Dr. Eugene Munroe, Entomological Research Institute, Canada Department of Agriculture, Dr. P. R. Gorham, Canadian Society of Plant Physiologists; *Canadian Society of Microbiologists:* Dr. Blythe A. Eagles, President, Dr. Armand Frappier, Director, Institut de Microbiologie, Université de Montréal, Dr. Norman Hinton, Chairman, Department of Biology, Queen's University, Dr. S. M. Martin, Senior Scientific Officer, Biology Laboratory, National Research Council; *Canadian Biochemical Society:* Dr. D. A. D'Iorio, President, Dr. D. R. Whitaker, Vice-President.

APPENDICES

- 101—Brief submitted by The Biological Council of Canada
- 102—Brief submitted by The Canadian Society of Microbiologists
- 103—Brief submitted by The Canadian Biochemical Society

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère

Grosart
Haig
Hays
Kinnear
Lamontagne
Lang
Leonard
McGrand

Nichol
O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, June 4, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Cameron, Carter, Giguère, Grosart, Haig, Kinnear, Phillips (*Prince*), Robichaud and Sullivan—11.

In attendance: Philip J. Pocock, Director of Research (Physical Science); Gilles Paquet, Director of Research (Human Science).

The following witnesses were heard:

BIOLOGICAL COUNCIL OF CANADA

Dr. James F. Stevenson, President
Dr. K. C. Fisher, Commissioner Survey of Biology, Science Secretariat
Dr. W. H. Cook, Past President
Dr. Eugene Monroe, Entomological Research Institute, Canada
Department of Agriculture
Dr. P. R. Gorham, Canadian Society of Plant Physiologists

CANADIAN SOCIETY OF MICROBIOLOGISTS

Dr. Blythe A. Eagles, President
Dr. Armand Frappier, Director,
Institut de Microbiologie, Université de Montréal
Dr. Norman Hinton, Chairman
Department of Biology, Queen's University.
Dr. S. M. Martin, Senior Scientific Officer
Biology Laboratory, National Research Council.

CANADIAN BIOCHEMICAL SOCIETY

Dr. D. A. D'Iorio, President
Dr. D. R. Whitaker, Vice-President

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

- No. 101—Brief submitted by The Biological Council of Canada
- No. 102—Brief submitted by The Canadian Society of Microbiologists
- No. 103—Brief submitted by The Canadian Biochemical Society

At 12.40 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

PATRICK J. SAVOIE,
Clerk of the Committee.

Curriculum Vitae

Cook, William Harrison, O.B.E., B.Sc., M.Sc. (Alta.), Ph.D. (Stanford), LL.D. (Sask.), D.Sc. (Laval), F.R.S.C. F.A.I.C. F.C.I.C., F.A.A.A.S., Executive Director, National Research Council of Canada. Dr. W. H. Cook was born in England in 1903 and graduated from the University of Alberta in 1928 with the degree of M.Sc. He received his Ph.D. degree from Leland Stanford University in 1931 and joined the National Research Council's Division of Applied Biology, becoming Director of this Division in 1941. This Division was subsequently renamed the Division of Biosciences and Dr. Cook continued as its Director until July 1968, when he was appointed Executive Director and assumed responsibility for the administration of the Council's Grants and Scholarships Programmes. Dr. Cook holds the degree of LL.D. (Honorary) from the University of Saskatchewan, and D.Sc. (Honorary) from Laval University. He is an Officer of the Order of the British Empire, awarded in 1946 for distinguished leadership in wartime research during the Second World War. Dr. Cook is a Fellow of the Royal Society of Canada, the Agricultural Institute of Canada, the Chemical Institute of Canada, the American Association for the Advancement of Science; a Charter Member of the Institute of Food Technologists, and a member of several other scientific societies. He has served as Honorary Secretary (1950-53) and President (1962-63) of the Royal Society of Canada, President of the Canadian Biochemical Society (1965-66) and President, Biological Council of Canada (1968-69). He is a member of the Agricultural Research Institute of Ontario, the Board of Governors of the University of Guelph, the Great Lakes Institute Advisory Board, and has served as chairman or member of numerous committees concerned with agriculture, scientific research and university support programmes. From 1943-47 Dr. Cook was Editor-in-Chief of the Canadian Research Journals, and from 1955-60 a member of the Board of Trustees of Biological Abstracts. He has served on a number of international organizations including: member of a United States-United Kingdom food mission to South America (1943); member of a Field Intelligence Agency technical team in Europe (1945); member of a United Nations Technical Assistance Administration Mission to Central America (1953); Vice-President, Executive Committee, International Institute of Refrigeration (1955-63); Foreign Vice-President, First International Congress of Food Science and Technology, London (1962); and Canadian delegate to the UNESCO Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere, Paris (1968). Dr. Cook's research interests include applied work on refrigerated storage and transport of perishable foods, and basic biochemical studies on proteins and lipoproteins. He is author of over 150 scientific and technical papers.

D'Iorio, Antoine. Born in Montreal, April 22nd, 1925. Married. Academic degrees and training: 1946, B.S. Biochemistry, University of Montreal; 1949, Ph.D. Biochemistry, University of Montreal; 1951-52, Post-doctoral Fellowship, Institute of Enzyme Research, University of Wisconsin; 1955-56, Post-doctoral

Fellowship, Department of Pharmacology, Oxford, England. Academic Position: 1949-51, Lecturer, Department of Physiology, University of Montreal; 1952-55, Assistant Professor of Physiology, University of Montreal; 1956-61, Associate Professor of Physiology, University of Montreal; 1961-69, Professor and Head, Department of Biochemistry, University of Ottawa; 1967, Secretary of the Faculty of Medicine; 1968, Vice-Dean of the Faculty of Medicine; 1969, Dean of the Faculty of Pure and Applied Science. Membership in Scientific Societies: Canadian Biochemical Society, Canadian Physiological Society, American Chemical Society, American Association of Biological Chemists, The Biochemical Society, New York Academy of Sciences, Society of Experimental Biology and Medicine, International Brain Research Organization, International Society of Neurochemistry, Royal Society of Canada (1969). Other relevant posts: 1956-61, Editor, *Revue Canadienne de Biologie*; 1962-67, Associate Editor, *Canadian Journal of Biochemistry*; 1958-61, Treasurer, Canadian Physiological Society; 1962-66, Hon. Treasurer, Canadian Federation of Biological Societies; 1968, Vice-President, Canadian Biochemical Society; 1959-61, Member of Executive and Council of the Associate Committee on Medical Research (NRC); 1959-62, Member of panel of the Associate Committee on Dental Research (NRC); 1967, Member of Executive and Council of The Medical Research Council; 1968, Vice-Chairman, Medical Research Council; 1962-65, Member of DRB panel on Shock and Plasma Expanders; 1963-66, Member of Selection Committee of the Ontario Mental Health; 1962-66, Member of the Canadian Foundation for the Advancement of Therapeutics; 1967, Member of the Grant Selection Committee of the Ontario Heart Foundation. Scientific Publications: 53 papers, 25 abstracts.

Eagles, Blythe Alfred. Born: New Westminster, B.C. on April 23, 1902—Married. Undergraduate work: At the University of British Columbia, 1918-1922, 1922-25: Dept. of Pathological Chemistry, Faculty of Medicine, Faculty of Graduate Studies, University of Toronto; 1926-28: Dept. of Organic Chemistry and Physiological Chemistry, Graduate School, Yale University, by arrangement through Graduate School with U.S. Dept. of Agriculture part of activities devoted to work at Connecticut Agriculture Experimental Station, New Haven and Bureau of Dairy Industry, U.S.D.A., Washington, D.C. 1928-29: National Institute for Medical Research, Hampstead, London, England. Degrees held: B.A. 1922, University of B.C. (First Class Honours in Chemistry & Biology); M.A. 1924, University of Toronto: Pathological Chemistry; Ph.D. 1926, University of Toronto: Major: Pathological Chemistry; Minors: Physiology and Biochemistry; D.Sc. 1969. University of British Columbia—Honorary. Academic awards and distinctions: 1922: Governor-General's Medal, UBC Chemistry Society—1st Prize, UBC; 1922-23: Teaching Fellow, Dept. of Pathological Chemistry, Faculty of Medicine; U. of Toronto: 1925-26: Senior Fellow, Dept. of Pathological Chemistry, Faculty of Medicine, U. of Toronto: 1926-29: Senior Sterling Post-Doctoral Research Fellow, Yale University: 1927; Reeve Research Prize, Faculty of Medicine, U. of Toronto (awarded annually for best published report of work done in the lab. by a research Fellow or junior member of the staff in any Dept. of the Faculty of Medicine;) 1928-29: Research Fellow, National Institute for Medical Research, Hampstead, London, England: 1934 (May 1-Sept 15): Visiting Research Scientist, Bureau of Dairying, U.S. Department of Agriculture, Washington, D.C. and Division of Dairy Research, Department of Agriculture, Ottawa, Ontario. 1952: Fellow of the Royal Society of Canada; 1958: Fellow

of the Chemical Institute of Canada; 1960: Fellow of the Agriculture Institute of Canada; 1960: Nuffield Foundation Canadian Travel Grant; 1967: Centennial Medal; 1969: Honorary Member of the Canadian Society of Microbiologists. Membership in profession and learned societies: Committee of Canadian Deans of Agriculture and of Veterinary Medicine Chairman, 1960, 1966, The Royal Society of Canada, Convener and Rapporteur, Biochemistry and Microbiology subsection, 1964-66. Member: Agricultural Institute of Canada; Canadian Microbiological Society, 1st Vice-President, 1967-68; President 1968-69; Canadian Biochemical Society; Canadian Physiological Society; The Biochemical Society; B.C. Institute of Agrolgists; Chemical Institute of Canada; Institute of Food Technology; B.C. Food Technologists. Public services: Member of the National Advisory Committee on Agricultural Services; Member of the Canadian Committee for Food Preservation; Member of the London Laboratory Advisory Committee; Member of the Advisory Planning Commission, Municipality of Burnaby; Director, Multiple Sclerosis Society of British Columbia; Director, Canadian Club, Executive, Vancouver, 1958-60 Committee on Research, The National Dairy, Council of Canada. Member of Senate 1936-42; 1949-67. Academic and professional experience (where and when) 1929-30, Assistant Professor of Dairying, the University of British Columbia, working under the Research Fund established jointly by the Empire Marketing Board and The University of British Columbia; 1930-32, Associate Professor of Dairying, The University of British Columbia, working under the Research Fund established jointly by the Empire Marketing Board and The University of British Columbia; 1929-32, Directing and carrying out research under the Grant—made to the University for studies on the process discoloration of pulp and paper; Sept. 1932-March. 1933, Research Chemist, Powell River Pulp and Paper Company, Powell River, B.C.; March, 1933-Sept. 1933 Research Assistant, Department of Dairying, University of British Columbia, under grant from the Empire Marketing Board and the National Research Council; Sept. 1933,-Dec. 1933, Assistant Professor, Department of Dairying, The University of B.C.; Jan. 1934-Apr. 1936, Associate Professor and Acting Head, Department of Dairying, The University of British Columbia; Apr. 1936-July 1949, Professor and Head, Department of Dairying, The University of B.C.; Aug. 1949-Jan. 1955, Professor and Head, Department of Dairying, Dean of Agriculture, The University of British Columbia; Jan. 1955-June 1967, Chairman, Division of Animal Science, Professor of Dairying, Dean of Agriculture, The University of British Columbia; July 1, 1967, June 30, 1968: Lecturer to Dairying, Division of Animal Science; July 1, 1967, Dean Emeritus of Agriculture; July 1, 1967, August 31, 1967: Acting Dean of Agriculture, Acting Chairman of Animal Science; July 1, 1968, June 30, 1969: Lecturer in Dairying, Division of Animal Science; July 1, 1968, June 30, 1969: Honorary Lecturer in Biochemistry.

Fisher, Kenneth Clarke, B.A., M.A., Ph.D., D.Sc. (Hon.), F.R.S.C.; Born: November 5, 1911, Saint John, New Brunswick. Education: Public Schools of Saint John, N.B.; Acadia University, Wolfville, N.S. (B.A. 1932); University of Toronto, Toronto, Ont. (M.A. 1934, Ph.D. 1936). Married: Jean F. Manery of Chesley, Ontario. 2 children. Fellow of the Royal Society of Canada 1949; President, Science Section 1962-63. Appointments: *University of Maine*, Orono, Maine: instructor in zoology 1936-37. *University of Toronto*, Department of Zoology: assistant professor 1937; associate professor 1948; professor 1956;

chairman 1956-67. School of Graduate Studies: Chairman; Division II (Science) 1954, associate dean (for Division II, Science) 1956-63. *Marine Biological Laboratory*: summer instructor in physiology 1936-41. *National Research Council of Canada*: operational research scientist with Canadian army 1944-46. *Defence Research Board*: superintendent of the Defence Research Northern Laboratory at Fort Churchill 1950-51. Member of the Arctic Advisory Committee for several years. Chairman of the Human Resources Advisory Committee (3 years). Director of "A Study of Basic Biology in Canada" for the Science Council of Canada by the Biological Council of Canada and the Canadian Federation of biological Societies. (at present) Member of Board of Governors, Ontario Research Foundation. (at present) Offices held in local organizations: President, Ontario Society of Biologists; President, Toronto Biochemical and Biophysical Society; President, Royal Canadian Institute; Chairman, Association of the Teaching Staff, University of Toronto (several years); Publications: Author or co-author of approximately 50 scientific papers and editor of a book; Scientific speciality: cellular and comparative physiology.

Frappier, Armand, MD.: Born Salaberry de Valleyfield, Province of Quebec, Canada, November 26, 1904; Married Thérèse Ostiguy (1929). Four children: Lise, Monique, Michèle, Paul; Academic Degrees and Post-graduate Studies: a) Degrees—Diplomas and Certificates: B.A., Séminaire de Valleyfield, Université de Montréal, 1924; M.D., Université de Montréal, 1930; L.Sc., Université de Montréal, 1931; Diploma, Trudeau School of Tuberculosis, New York, U.S.A., 1932; Bacteriology Certificate, The Royal College of Physicians and Surgeons of Canada, 1946; Bacteriology Certificate, The College of Physicians and Surgeons of the Province of Quebec, 1950; b) Post-graduate studies abroad: 1931-1932 (Rockefeller Fellow); Department of Bacteriology, Rochester University, New York, N.Y., U.S.A. (professor Bayne-Jones); Laboratory of Hygiene, New York State Department of Health, Albany, N.Y., U.S.A. (Dr. Wadsworth); Laboratory of Hygiene of New York City, New York, U.S.A. (professor William Park); Sanatorium des Adirondacks, Saranac Lake, N.Y., U.S.A. (professors Baldwin & Petroff); 1932: Laboratoires de la Tuberculose, Institut Pasteur de Paris, (professors Calmette, Guérin, Nègre); 1937, Laboratoires des vaccins et anatoxines, Institut Pasteur de Paris, Annexe de Garches (professor Ramon). Honours Awarded: 1946, Order of British Empire (O.B.E.); Honorary Member, Canadian Red Cross Society; 1948, Officier d'Académie (avec palmes); 1964, Doctorat *Honoris causa* de l'Université de Paris, November 5. Awards and Medals: 1937, Prix Casgrain et Charbonneau; Award of the Canadian Medical Association for the scientific exhibition of works on BCG; 1945, Prix Casgrain et Charbonneau; 1948, Ciba Award, Montreal Medical Society, Médaille de l'Institut Pasteur, Medal of the Montreal Medical Society; 1954, Médaille Archambault, ACFA; 1957, Médaille de l'Académie nationale de Médecine, France; 1963, Honorary diploma (received in the name of the Institute) for the participation of the Canadian delegation to the 8th International Congress of Leprology, Rio de Janeiro, Brazil; 1964, Médaille "Bene Merenti" (médaille du Mérite diocésain), Diocèse de Valleyfield, Province of Quebec; Certificat d'honneur en appréciation des services rendus à l'Expédition médicale canadienne à l'Île de Pâques et au peuple de Rapa-Nui; 1967, Citoyen honoraire of his birth place, Salaberry de Valleyfield. Positions held: Laboratory aid, Faculty of Sciences and Faculty of Medicine, Université de

Montréal (1924-1927); Laboratory assistant, Faculty of Sciences and Faculty of Medicine, Université de Montréal (1927-1928); Assistant-chemist, Hôtel-Dieu de Montréal (1927-1929); Head of laboratory, Hôpital de la Miséricorde, Montreal (1927-1930); Head of laboratory, Hôpital St-Luc, Montreal (1927-1943); Demonstrator, Faculty of Medicine, Université de Montréal (1929-1930); Lecturer, Faculty of Medicine, Université de Montréal (1930-1931); Assistant professor of Bacteriology, Director of the BCG Laboratories, Faculty of Medicine, Université de Montréal (1932-1938); Head of the Department of Bacteriology, Faculty of Medicine, Université de Montréal (1932-1964); Associate professor, Department of Bacteriology, Faculty of Medicine, Université de Montréal (1938-1950); Founder and Director of the Institute of Microbiology and Hygiene of the University of Montreal, 1938-...; Director of studies of the School of Hygiene, Université de Montréal (1945-1964); Titular Professor, Founder and Dean of the School of Hygiene, Université de Montréal, (1945-1965); Titular Professor, Department of Bacteriology, Faculty of Medicine, Université de Montréal, 1950-... Associations and Learned Societies: a) National, Royal Society of Canada (Nominating Committee, Microbiology and Biochemistry Subject Division, 1962-...); Canadian Society of Microbiologists, (President, 1954-1955), (Chairman, Award Committee, 1962-1965); Society of Microbiology of the Province of Quebec, (President, 1952-1954); Société de Biologie de Montréal, (Secretary, 1935-1937); President, Montreal Medico-Chirurgical Society; Société Médicale de Montréal, (President, 1946); Société de Phtisiologie et de Pneumologie de Montréal, (Honorary Member, 1961); Association des Médecins de Langue française de l'Amérique du Nord; Canadian Tuberculosis Association (Member, Research Committee, 1959-1964); Association des Microbiologistes de Langue française; Canadian Public Health Association; Canadian Physiological Society; Association Canadienne-Française pour l'Avancement des Sciences (ACFAS); Société de Médecine vétérinaire de la Province de Québec, (Honorary Member); Société médicale de Valleyfield, (Honorary Member); Société médicale de Chicoutimi, (Honorary Member); Canadian Medical Association, Quebec Division (Member, Committee on Public Health, 1946-1953); Chapter of Sigma XI (McGill); Canadian Association for the Advancement of Health Sciences; Société canadienne de Biologie cellulaire. b) Foreign or international: Académie nationale de Médecine, France, (Foreign corresponding member); American Public Health Association (Fellow), Vice-president, Canadian Section (1965-1966); International Association of Microbiological Societies, (Member of the Nomenclature Committee, (1962-...), (Member of the Canadian Committee); Royal Society of Health (London), (Fellow); Royal Society of Medicine (London), (Fellow); Société française de Microbiologie, 1957-...; Société médicale des Hôpitaux de Paris, (Corresponding Member); American Association for the Advancement of Science, (Fellow); Société d'Hygiène de Langue française (Paris); Société de Pathologie exotique (France); Société de Pathologie comparée; New York Academy of Sciences; American Society for Microbiology. Public Health Organizations: a) National, Commission of Hygiene of the Montreal Board of Health, (President, 1959-...); Dominion Council of Health, (Member, 1962-...); National Research Council (Canada), (Member, Advisory Committee on Tuberculosis, 1934-1938); (Member, Advisory Committee on Medical, Research, Division of Medical Researches, 1952-1955); (Member,

Associate Committee on Culture Collections and Taxonomy of Microorganisms, 1963-...); Department of National Defence (Canada), (Chairman, Sub-Committee on Stable vaccines related to BW Defence (Advisory Committee on BW Research), (1962)); Defence Research Board (Canada), (Member, Panel on Infection and Immunity, 1960-1963), (Chairman, Advisory Committee on Biological Warfare, 1963-68); Department of National Health and Welfare (Consultant, Indian Medical Services, 1946-1950), (Member, Advisory Committee on Public Health Research, 1954-1960), (Member, Special Weapons Working Party Sub-committee on Communicable Disease Identification and Notification, 1956-1957), (Member, Advisory Committee on Influenza, 1957); Canadian Red Cross Society, (Member, Executive Committee, Quebec, Provincial Division, 1943-1964); Health League of Canada, (Consultant, 1947-...), (Member, National Advisory Directors, 1949-...); Health Survey Technical Committee of the Province of Quebec, (Member, 1948), (Chairman, Sub-committee on Research, 1948-1951); Provincial Committee for the Prevention of Tuberculosis, (Member, Research Sub-committee, Medical Section, 1962-...); Comité consultatif provincial de la Recherche en Hygiène publique de la Province de Québec (Président, 1951-1960); Conseil de la Recherche médicale du Québec (Chairman, Sub-committee on Public Health, 1964-...); Conseiller honoraire pour la recherche médicale, Easter Island Expedition (1964); MRC Assessment Group on Preventive Medicine, 1967. b) Foreign or international, World Health Organization, (Member, Expert Committee on Tuberculosis, 1953-...); International Union against Tuberculosis (President, Commission on BCG, 1957-1963); Société d'Hygiène de Langue française (Paris), (Member, Board of Directors, 1964-...); Haitian-American Tuberculosis Institute, (Member, Board of Directors, 1961); O Instituto Brasileiro Para Investigação da Tuberculoses, (Corresponding Member, 1952). Professional and social organizations; National, Université de Montréal, (Member, Commission des études, 1945-65), (Library, Sub-committee, 1960-1965), (Member, Advisory Committee of the Health Service, 1962-65); Clinique BCG and Hôpital Marie-Enfant, (Member, Board of Directors, 1946-...), (Member, Medical Board, 1949-...), (Vice-president 1950-...), (Membre, Comité de prévention des infections, 1966-...); Quebec Hospital Service Association, (Member, Executive Committee, 1948-1950); Canadian Legion, (Trustee, Quebec Chapter, Canadian Foundation for Poliomyelitis and Rehabilitation, 1949-65); Montreal Antituberculosis League Inc. (Governor, 1955-...); Combined Health Appeal of Greater Montreal, (Member, Board of Governors, 1962-...), (President, Advisory Committee on Services, 1963-...); Royal College of Physicians and Surgeons of Canada, (Member, Committee in Bacteriology, 1962-1964); Committee on Royal College Qualifications for Public Health Physicians, (Member, 1962-...); Institut scientifique franco-canadien, 1964-...; Société d'Hygiène et de Médecine préventive de la Province de Québec; Biological Council of Canada, (Vice-president, 1966-1968, and Representative of the Canadian Society of Microbiologists on the same). Achievements: Has organized diagnostic laboratories for many hospitals, particularly Hôpital St-Luc in Montreal; Has organized the Department of Bacteriology of the Faculty of Medicine of the Université de Montréal and given a great stimulus to teaching of Microbiology at graduate and post graduate levels in the concerned faculties; Founder of the Institute of Microbiology and Hygiene

of the University of Montreal (1938); Founder of the School of Hygiene of the Université de Montréal (1945); Pioneer in the BCG study and vaccination in Canada and North America; Has contributed to the foundation and organization of the Red Cross Blood Donors Clinics in the Province of Quebec during the 1939-1945 war; Has organized human Normal Serum Desiccation laboratories, during the 1939-1945 war, at the Institute of Microbiology and Hygiene of the University of Montreal; Has organized the production of Salk and Sabin vaccines against poliomyelitis, anti-influenza and measles vaccine, and also experimental rubella vaccine at the Institute of Microbiology and Hygiene of Montreal University; Has pioneered virus studies in Canada and organized the first diagnostic laboratory of virus diseases in Public Health for the Province of Quebec. Missions and Formal Invitations: Has attended many scientific meetings and congresses all over the world, as Canadian Delegate; Has been an observer at the American National Research Council (Committee on Shock and Blood Substitute), Washington, D.C., 1943, for the NRC (Canada); Has been invited by the French Government to the "Congrès des Sciences pastoriennes" in 1946 and to the "Congrès du BCG" in 1948; Has delivered conferences at the Faculté de Médecine, Paris, in 1946 and 1956; In 1948, was Technical Consultant of the Canadian Delegation of the First Meeting of the World Health Organization in Geneva; In 1952, has visited the most important scientific research centers in Europe, in order to complete his survey on the organization of medical research in the world and in Canada; In 1953, in Copenhagen, has participated in a meeting of the Expert Committee on Tuberculosis of the World Health Organization; Has been assigned many health study missions among the Indians of the North of the Province of Quebec; Has prepared, in 1953, a report on the organization of medical research in Canada for the Governments of Quebec and Canada; Has been a rapporteur at the International Technical Conference on BCG (International Union against Tuberculosis), held in Geneva, in 1956. On this occasion, he had prepared a report on "The BCG Strain"; In 1957, has toured India and Japan to fulfill a mission under the auspices of the Columbo Plan related to the Fight against Tuberculosis; Under the auspices of the Commission on BCG of the International Union Against Tuberculosis, has organized an Interlaboratory Experimentation Group on Methods for the Study of BCG. The international experiment was coordinated by Professor Maurice Panisset. Within the XVIth Conference of the International Union Against Tuberculosis has organized a Round Table Discussion, held in Montreal on September 7, 8 and 9, 1961 and gathering together the above group with consultants of international standing. Report of this meeting was published under the form of a book jointly by the Institute of Microbiology and Hygiene of the University of Montreal and the Institut Pasteur de Lille; Has organized a similar meeting within the XVIIIth International Conference on Tuberculosis held in Munich, on October 5 to 9, 1965. The same group discussed there the results of an interlaboratory experiment bearing on Comparison of the immunizing power of four BCG daughter-strains; Has been invited by the Institut Pasteur de Paris to the "Centenaire de la naissance de Calmette" in 1963; Travelling Seminar (Beyruth, Ankara, Cairo) under the auspices of the Association of North American Public Health Schools and WHO, 1965.

TRAVAUX SCIENTIFIQUES

1. Publications originales: 1935, "Autres observations sur l'allergie à la tuberculine chez le cobaye vacciné au BCG". Frappier, A. et Fredette, V. Union méd. Canada, 1(1). "Some observations on the allergy to tuberculin of guinea pigs vaccinated with BCG". Frappier, A. and Fredette, V. Canad. J. Res., 12(2): 165-176, février; 1936, "A bacteriological study of the new surgical mask "JEL". Frappier, A. and Forté, L. Canad. Med. Ass. J., 34: 547-549, mai. "Ensuring the safety of BCG vaccine by animal inoculation". Frappier, A. and Fredette, V. Canad. J. Publ. Hlth., 27(11): 563-568; 1937, "La prémunition contre la tuberculose par le BCG. Étude critique et expérimentale". Union méd. Canada, 66(4): 158-169; 1939, "Comparaison de deux méthodes d'appréciation de la sensibilité dermique à la tuberculine: celle de la recherche de la dose réactionnelle minimum et celle de l'évaluation de l'intensité des réactions à une dose forte chez le cobaye". Frappier, A. et Fredette, V. C.R. Séances Soc. Biol. (Paris), 131: 491-494. (séance du 3 juin); "Désensibilisation dermique aux faibles doses de tuberculine". Frappier, A. et Fredette, V. C.R. Séances Soc. Biol. (Paris), 131: 642-645. (séance du 10 juin); "Influence de la voie d'inoculation et de la virulence des bacilles tuberculeux sur le développement et l'évolution de la sensibilité dermique à la tuberculine chez le cobaye". Frappier, A. et Fredette, V. C.R. séances Soc. Biol. (Paris), 131: 760-763. (séance du 17 juin); 1941, "La vaccination préventive contre la tuberculose". Union méd. Canada, 70(1): 45-54, janvier; 1945, "La résistance antituberculeuse du cobaye vacciné au moyen du BCG par des piqûres superficielles et multiples de la peau (méthode de S. R. Rosenthal)". Frappier, A. et Denis, J. Rev. canad. Biol., 4(3): 334-345; 1946, "Recherches sur l'immunité dans la gangrène gazeuse. I. Valeur comparative de sérums anti-perfringens de type antitoxique et de type mixte antitoxique-antibactérien". Fredette, V. et Frappier, A. Rev. canad. Biol., 5(4): 428-435; "Recherches sur l'immunité dans la gangrène gazeuse. II. Action déchainante de filtrats non toxiques de culture de *Cl. perfringens* dans la gangrène gazeuse expérimentale". Fredette, V. et Frappier, A. Rev. canad. Biol., 5(4): 436-441. 1948, "Some experimental and clinical observations on the stability of BCG vaccine". Frappier, A. 4th International Congress Tropical Medicine & Malaria, Washington, D.C., U.S.A., 10-18 mai. Proceedings, 1: 187-201. 1949, "Effets du sérum anti-cytotoxique sur la formation des antitoxines chez des chevaux en voie d'hyperimmunisation". Panisset, M., Frappier, A., Masson, A. M. et Marois, P. Bull. Acad. vét. France, 102: 145-150; "Histoplasmin Sensitivity. II. A brief study of the incidence of hypersensitivity to Histoplasmin in an Indian Tribe of Northern Quebec". Guy, R., Panisset, M. and Frappier, A. Canad. J. Publ. Hlth., 40(7): 306-309, juillet; "The use of BCG". Frappier, A. and Guy, R. Canad. Med. Ass. J., 61: 18-24. 1950, "A new and Practical BCG skin Test (The BCG Scarification Test) for the Detection of the total tuberculous Allergy". Frappier, A. and Guy, R. Canad. J. Publ. Hlth., 41(2): 72-83. 1951, "Étude de la distribution des anticorps neutralisant la souche Lansing et de l'incidence de la poliomyélite au cours d'une épidémie hivernale dans une population isolée". Pavilanis, V. et Frappier, A. Ann. Inst. Pasteur, 81(6): 583-607; "The technique of Radioisotopes in Microbiology". Sternberg, J. and Frappier, A. Radioisotope Techniques, Vol. I, Medical and Physiological Applications. (Proc., Isotope Techniques Conferences, Oxford, juillet); 1952, "A Tuberculosis Survey in the largest Mental Hospital of the

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14-35; "Obtention comparative de l'antigène protecteur coquelucheux par lavage et par lyse du bacille *H. pertussis*". Frappier, A. Guérault, A. et de Repentigny, J. VII^e Congrès international de Pathologie comparée, Lausanne, Suisse, 26-31 mai. Comptes Rendus, II: 142-150. 1956, "Action protectrice de la gamma-globuline humaine contre une infection staphylococcique expérimentale". Sonea, S., Frappier, A. et Borduas, A. G. Union méd. Canada, 85(9): 1028-1032; "L'immunité dans les infections staphylococciques. I- Action de l'antitoxine contre une infection bactérienne expérimentale". Frappier, A. et Sonea, S. Canad. J. Microbiol., 2(3): 271-280; "Recherches faites avec les mycobactéries marquées. VI- Dispersion du BCG marqué au P32 chez le cobaye". Sternberg, J. et Frappier, A. Ann. Inst. Pasteur, 90(5): 533-574; "Studies on *H. pertussis* liquid cultures. III- Localization of surface antigens by means of fluorescent antibody". de Repentigny, J. and Frappier, A. Canad. J. Microbiol., 2(7): 677-683. 1957, "Activité anticoquelucheuse des gamma-globulines humaines provenant d'adultes normaux". de Repentigny, J., Frappier, A., Borduas, A. G. et Desnoyers, J. Union méd. Canada, 86(4): 371-374; "Primary resistance of tubercle bacilli to streptomycin and other antituberculous agents in the Province of Quebec". Frappier, A., Desjardins, R. and Panisset, M. Canad. Med. Ass. J., 76(8): 653-655; "Value of tuberculin reactions for the selection of cases for BCG vaccination and significance of Post-vaccination allergy: 1- Development of tuberculin sensitivity following BCG vaccination. Qualitative and quantitative method of testing. 2- Influence of antigenic qualities of the strains upon allergy. 3- Properties affecting the allergizing potency of the BCG vaccine". Frappier, A. Symposium, XIVth Internat. Tuberc. Conference, New Delhi, India, 7-11 janvier 1957. Bull. Internat. Union against Tuberc., 27(1-2): 1957; "Rapport". Panisset, M. et Frappier, A. Conférence internationale technique du BCG, Genève, Suisse, 2-6 octobre 1956. Bull. Union internat. contre Tuberc., 27(1-2): 71-79, janvier-avril 1957. Bull. Internat. Union against Tuberc., 27(1-2): 73-80, January-April 1957. 1958, "A winter epidemic of poliomyelitis in Saint-Augustin, Quebec. III-Laboratory studies". Pavilanis, V. and Frappier, A. Canad. Med. Ass. J., 79(1): 11-14; "Combined protective action of human gamma-globulin and antibiotics when administered simultaneously in experimental staphylococcal infection". Sonea, S., Borduas, A. G. and Frappier, A. Rev. canad. Biol., 17(1): 110-115; Symposium sur la vaccination au BCG par voie buccale, Paris, 20-28 septembre 1957. Bull. Union internat. contre Tuberc., 28(1-2): 92-133; "Evaluation of the effectiveness of anti-influenza vaccination". Pavilanis, V., Frappier, A., Somlo, F., Boudreault, A. and Claveau, P. Canad. Med. Ass. J., 79(7): 527-532; "Mechanism of immunity in tuberculosis". Frappier, A. J. Exper. Med. Sci. (India), 1(4): 135-147; "Some biological properties of BCG after the extraction of lipids: the power to irritate tissues, the ability to prepare for and to evoke Bail's phenomenon, and the power to sensitize to tuberculin". Portelance, V. and Frappier, A. Canad. J. Microbiol., 4: 409-420; "The BCG strain: newer knowledge of its biology and identification". Frappier, A. and Panisset, M. Canad. Med. Ass. J., 78(2): 103-108. 1959, "Some biologic properties of Mycobacteria following the extraction of lipids. The power to initiate acquired resistance". Frappier, A., Portelance, V. and St-Pierre, J. Amer. Rev. Tuberc. & Pulm. Dis., 79(3): 296-306; "Staphylococcal infection in hospital nurseries. Influence of three different nursing techniques". Frappier-Davignon, L., Frappier, A. and St-Pierre, J. Canad. Med. Ass. J., 81(7): 531-536; "Un caractère différentiel des sous-souches du

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27. Assessment of the Prolonged Effect of Antiseptic Scrubs on the Bacterial Flora of the Hands. *Canadian Medical Association Journal* 99: 402-407, 1968.

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- The Epidemiology of *Proteus* Urinary Tract Infection.
- A Long-Term Study on the Nasal Staphylococcal Carrier.
- A System of Classification of Postoperative Wound Infection.
- A Study of the Immunosuppressive Activity of Chloramphenicol.
- Characterization of Immune Responses in Dogs.

Formal papers on all of these subjects have been presented at various meetings.

Martin, Stanley M. Born in Ottawa, October 26, 1920; Public and high school in Ottawa; B.S.A. (Toronto) in bacteriology, 1944; M.S. (Wisconsin) in bacteriology, 1949; Ph.D. (Wisconsin) in bacteriology/biochemistry, 1950; R.C.N.V.R. (Special Branch) 1944-1946; Employed with National Research Council, Ottawa since 1950. Currently a Senior Scientific Officer in Biology Laboratory. Research interests have been: 1) Production of citric acid by fungi; 2) Mode of formation of citric acid by fungi; 3) Proteolytic enzymes from fungi; 4) Cultivation of, and production of metabolites by cells of higher plants growing in tissue culture (current interest), Broad interest best described as "industrial microbiology"; Councillor (industrial microbiology); Canadian Society of Microbiologists; Secretary-Treasurer, Section on Culture Collections, International Association of Microbiological Societies; Representative of the Canadian Society of Microbiologists at the Senate Hearing.

Munroe, Eugene Gordon, B.Sc., M.Sc., Ph.D., F.R.S.C. born in Detroit, Michigan, U.S.A., 8 September 1919, came to Canada 1927, naturalized 1932. B.Sc. first class honours zoology, McGill University, 1940; M.Sc., entomology, McGill University 1941; Ph.D., entomology, Cornell University 1947. Served in R.C.A.F. 1942-45, terminal rank Flying Officer. Now Research Scientist, Canada Department of Agriculture (1950-65 and 1968-present); Science Adviser, then Principal Scientific Adviser and Head of Studies, Science Secretariat (1965-68); Lecturer and Research Assistant, Institute of Parasitology, Macdonald College, Que. (1946-50); Visiting Professor, University of California, Berkeley (1959-60); Honorary Lecturer, Carleton University (1965-66); Chairman, Interdepartmental Appraisal Committee for Research Scientists (1966-68); Member, Interdepartmental Advisory Committee on Scientific Personnel (1960-66); Member, International Commission on Zoological Nomenclature (1964-present); Member, Steering Committee, Biological Council of Canada (1964-65). Fellow of the Royal Society of Canada (Chairman ABSD nominating committee); Fellow of the Royal Entomological Society of London; Member, Entomological Society of Canada, (President, 1964; Editor, *The Canadian Entomologist*, 1957-1960; Chairman, Finance Committee, 1968-present); Member, Entomological Society of Ontario; Member, American Association for the Advancement of Science; Member, Lepidopterists' Society (President, 1959; Member, Editorial

Committee, 1955-president); Member, Canadian Society of Zoologists; Member, Entomological Society of America; (member, Memorial Lecture Committee, 1966-present, Chairman, 1967); Past Member and Director, Professional Institute of the Public Service of Canada. Field and laboratory experience in many countries, including most states, provinces and territories of USA and Canada; also Britain and Western Europe, 1934, 1935, 1936, 1953, 1958, 1964, 1965; USSR and Rumania 1958; South and East Africa, 1935-36; West Indies and South America, 1937, 1938; Pacific Islands, Australia, New Guinea and Thailand, 1957. Author of some 130 scientific publications, in the fields of insect classification, biogeography, ecology, science policy and scientific biography, including 13 papers now in press.

Stevenson, James A. F. Born, Nanton, Alberta, March 15, 1918; Schooling: 1937, B.A. (Honours), McGill University; 1938, M.A. (Psychology), McGill University; 1942, M.D., C.M., McGill University. Positions Held: 1937-38, Demonstrator, Department of Psychology, McGill University; 1941-42, Interne, Children's Memorial Hospital, Montreal; 1942-43, Interne, McGill University Clinic, Royal Victoria Hospital, Montreal; 1943-44, Captain, RCAMC. Seconded to McGill University Clinic; 1945-46, Assistant, then Nutritional Advisor, D.M.S., C.A.O.; Major, RCAMC; 1946, Caverhill Fellow (McGill University), Department of Physiological Chemistry, Yale University; 1946-48, Research Assistant, Instructor, Department of Physiological Chemistry, Yale University; 1948-50, Research Assistant—Assistant Professor, Departments of Physiology and Psychiatry, Yale University; 1950-51, Associate Professor, Department of Medical Research; Lecturer, Department of Physiology, University of Western Ontario; 1951, Professor and Head, Department of Physiology, University of Western Ontario; 1967, Honorary Lecturer, Department of Psychology, The University of Western Ontario; Honorary Consultant, Victoria Hospital, London, Ontario; Honorary Consultant, St. Joseph's Hospital, London, Ontario; Research Consultant, Westminster Hospital (DVA) London, Ontario; 1960-63, Editor (Physiology and Pharmacology) Canadian Journal of Biochemistry and Physiology; 1964, Editor, Canadian Journal of Physiology and Pharmacology; 1966, Editorial Advisory Board, Physiology and Behavior; 1968, Editor, Newsletter, International Union of Physiological Sciences. Societies: Royal Society of Canada, Fellow 1968; Canadian Physiological Society, Council 1953-56, Secretary 1956-60, President 1964-65; Pharmacological Society of Canada; Canadian Biochemical Society; Canadian Federation of Biological Societies, Honorary Associate Secretary 1958-60; Biological Council of Canada, Vice-President 1968-69; Nutrition Society of Canada, Council 1965; Canadian Society of Clinical Chemists; Canadian Society for Clinical Investigation Council 1955-58; Ontario Medical Association; Canadian Medical Association; American Physiological Society, (Neuroendocrine Group—Steering Committee), (Education Committee—Member, 1967-), (Visiting Scientists Committee—Member, 1967-); Endocrine Society; Sigma Xi; Alpha Omega Alpha; Baconion Society of London, Secretary 1962-63, President 1964-65. Councils and Committees: Canadian National Committee for Physiology, (International Union of Physiological Sciences) 1963-66; International Conference on the Regulation of Food and Water Intake, First Conference, Leiden, 1962, Organizing Committee; Second Conference, Tokyo, 1965, Secretary, Organizing Committee; Canadian

Council on Nutrition, Member 1954-59, 1962, Canadian Heart Foundation, Scientific Subcommittee, 1958-63; Defence Research Board, Panel on Nutrition and Metabolism, Member 1951, Chairman 1955-58; Panel on Shock and Plasma Expanders, Member 1954-63, Chairman 1958-63; Defence Medical Research Advisory Committee 1955-63; Defence Research Medical Laboratories Consultant 1958; Alcoholism and Drug Addiction Research Foundation (London), Professional Advisory Committee; The University of Western Ontario, Member of Senate 1966-, Member of Board of Governors 1968.

Whitaker, Donald Robert, B.Sc., Ph.D., D.Sc. Vice-President, Can. Biochem. Soc. (Principal Research Officer, N.R.C.). Born in St. James, Man. in 1919. B.Sc. (Manitoba) in 1941, R.C.A.F. 1941-45, Ph.D. (London) in biochemistry in 1948. On staff of N.R.C. since 1948. D.Sc. (London) in 1963. Research area—production, structure and function of enzymes from microorganisms. Member of Can. Biochem. Soc., Biochemical Soc. (U.K.), American Soc. of Biological Chemists, Chemical Soc. (U.K.), American Chemical Soc., Society for General Microbiology (U.K.).

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, June 4, 1969

The Special Senate Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, as you know we have quite a big day today. These are all big days, with a heavy schedule. I must remind you that while we are meeting this morning, we will meet again at 8 o'clock this evening, when we will receive the various representatives from the medical profession. This morning we are pretty close to the medical profession, since we will meet with the representatives of various biological societies. Biology, of course, is a more general field than medicine. It is, I suppose, speaking as an economist and as a layman, more or less, at the base of one of the basic sciences which serve medicine.

We are very happy to have these guests this morning. As usual I will ask a representative of each of the three societies in attendance to make a short opening statement. Then we will have the question period. I will proceed by the order on my sheet of paper. First, Dr. James Stevenson, who is the President of the Biological Council of Canada.

Dr. James F. Stevenson, President, Biological Council of Canada: The Biological Council of Canada is grateful for this opportunity to present our brief. The Council is a general policy council representing some 14 scientific associations for biology in Canada.

Speaking for biology overall in Canada we feel that there are urgent national problems in biology, food production, the control and adaptation to our environment and health, which comes to the personal side of biology and is represented in the sciences that we speak for here as well as by the medical profession and the allied health professions which will speak to you later. I would draw

your attention to the fact that biology consists of an interrelated group of sciences. This is why you hear from so many spokesmen for it. We ourselves as individuals find the problems become very complex, so this is why there must be so many special studies in this broad field. There is a very great need for competent people in biology and because of the size of our country this has been hard to achieve in the past.

What we need in many centres is a critical mass of scientists so that they stimulate one another and lead to a much better production of science for our country. Our resources appear yet to be comparatively limited, and we would draw your attention to the section on this in the brief.

We would also ask you to take notice of our recommendation with regard to policy in biological science. The national goals are, of course, a matter for political decision on behalf of the community, but once the decision about national goals is made, then it is a scientific decision as to how best to achieve these in terms of the field of biology and other sciences.

We would draw your attention to the fact that the ability to achieve even the most applied goal, from the point of view of the community, in biological and health matters really demands personnel and knowledge, and derives from the support and development of pure sciences so that there may be a pool of people and a pool of knowledge to solve these applied problems. We would also emphasize that we feel the federal Government has a major and most important role to play in the support of research.

The recommendations made in the brief are that there be an increased support of basic biology, because from this derives all of the ability to apply this knowledge of the world to our problems and to achieve the solutions. This would include, of course, support of the health sciences, upon which other briefs have

already been presented to you. We think it important that we should study the maintenance of the environment in Canada because of the problems of adaptation. We as Canadians have a particular problem, since half our country is cold all of the time and the other half of the country is cold half of the time. We also face very serious problems of pollution of our environment, and this calls for both pure and applied research. We would hope the Government would be able to encourage increased participation by industry in both pure and applied biological research.

With regard to the administration of national science policy, the suggestion is made that a minister without other duties might represent science in the Cabinet. This is really what we are asking for here, some overall—although not confining the overall—policy of organization for science in Canada.

One of the other suggestions is that, from the point of view of biology, a biological research board or council as part of the National Research Council should perhaps be established. This is more an administrative arrangement rather than the establishment of a completely new crown agency, to give biology a definite voice.

However, I think the most important recommendation we make is that this Special Senate Committee on Science Policy should be maintained. I venture to say that most of the briefs you have received have come from executives of the various scientific societies and so forth, and the individual Canadian scientist has not really had an opportunity to react to the Senate's interest and the Government's interest in this in general. I think that from your first report and your first recommendations there will be a feedback from the scientists of the country, which will be most valuable in defining a more permanent policy. We would therefore plead with you to keep what is becoming a forum for the scientists—a direct voice to Parliament if you like for the scientists—a continuing thing. We think this will be most valuable and will increase the morale of scientists in Canada as well as advising the Government on scientific policy.

Finally, we would suggest that some plan is needed for Canada so that any Canadians going into science, whether it be pure science or the application of science, such as in the health profession, agriculture, fisheries and so on, will see a future in this country.

The Chairman: Thank you very much, Dr. Stevenson.

We will now hear from Dr. D'Iorio, President of the Canadian Biochemical Society.

Dr. A. D'Iorio, President, Canadian Biochemical Society: Mr. Chairman, honourable senators, I asked Senator Lamontagne a few minutes ago whether I could speak in French, but apparently there are no interpreters.

The Chairman: We are poor in the Senate.

Dr. D'Iorio: You will have to be satisfied with my own version of the common language in Canada—broken English.

I do not wish at this stage to read all the brief we have presented. The one we have submitted to the Senate is extremely short. However, I should like to apologize for the French version because of the lack of time we had at our disposal. I think it was done within two hours, and after re-reading it I must admit that it shows. For this I apologize.

As a biochemist, I would like to indicate that biochemistry is one of these odd disciplines that sits in the middle of biology and chemistry. For this reason, of course, biochemists in Canada not only belong to the Canadian Biochemical Society, but most of us belong to the Canadian Institute of Chemistry, thus indicating this dichotomy.

I would wish to point to a few of our recommendations. One is that biochemists are very strongly in favour of national laboratories. Maybe the form this national laboratory should take is not necessarily the one presently existing. We are in favour of continuing research institutes throughout the country, but probably they should be more decentralized than they are at the moment, and have a closer relationship with university laboratories.

Like the Biological Council of Canada, we wish to make a strong plea for some political action to encourage the establishment in Canada of research laboratories from industry, mainly pharmaceutical industries, which in other countries have extremely large research endeavours but which in Canada have done very poorly.

Apart from that, I only want to say this with regard to policy. In our own brief we took a very narrow sort of attitude, and we were thinking of science policy as a sort of monolithic structure that would eventually

direct research. We have been brought up to be against this sort of structure, and we are worried about it. However, we realize that there should be within the Government—probably at a very high level of government—some sort of structure to coordinate the efforts, not only of the agencies distributing funds to universities, but also the research going on in various government laboratories, ministries and so on. This is the sort of thing we would very much like to put forward to this committee.

We would also wish to add that we like the diversity of agencies that are funding research. Rather than having one central body distributing all the money, we are very much in favour of having the numerous agencies that presently exist. Because of the different points of view within these agencies, a scientist might find it easier to deal with one rather than another.

These days it is very fashionable to talk about "mission-oriented research". Obviously some of these agencies favour mission-oriented research. For instance, Dr. Armstrong's heart foundation is one such agency which will pool efforts in a given direction. I think this is really what mission-oriented research should be all about.

In our own short brief we did not speak about the problems mentioned by the Biological Council of Canada, but like them we are also in favour of trying to identify the major problems we should tackle in Canada. Pollution is one that I think faces the whole of humanity, and it is one about which we have to be very concerned.

That is all I want to say at this stage, except to thank this committee for the opportunity to voice our feelings about science. For once we have the impression that probably the Government is interested in scientists, whereas up to now we have always had the impression that maybe we were in our little ivory tower and nobody would ever bother us. I believe it is very good for us to be exposed to this. I realize the tremendous amount of work you have to do in digesting the numerous briefs presented to you, but since this is good democracy, and as some of the briefs are very contradictory, I think you will need great latitude in writing your final report.

The Chairman: Thank you very much. Dr. D'Orio.

Dr. D. R. Whitaker, the Vice-President of the Canadian Biochemical Society is also with us this morning. He is now the President-elect of the society, and during the discussion period we would welcome any additional remarks that he might like to make.

Finally we will hear from Dr. Blythe Eagles, the President of the Canadian Society of Microbiologists.

Dr. Blythe A. Eagles, President, Canadian Society of Microbiologists: Mr. Chairman, honourable senators, it is a very great pleasure for me to be here, together with a number of supporting members of our society who are meeting in Ottawa this week. Although to begin with we showed reticence in sending a report, because many of our members take part in the Biological Council of Canada and other societies, we very much welcome the opportunity of participating in this debate. We have confined ourselves to a corporate report, and are really speaking for individual scientists and not for any other kind of organized body. I think that was brought out a little earlier. In so doing we are a very inter-disciplinary group.

It is difficult to define just what a microbiologist is, where microbiologists come from and what they do. Since our beginning 19 years ago, we have also been very conscious of the difference between basic and applied work and we have tried to bring these things together in a personal and impersonal way.

In summary, in our report we have emphasized the question of education at all levels and in all phases, whether or not it is at the highest level, the applied, vocational and doctoral level, or even post-doctoral. We have tried to confine it to the activities of micro-organisms and it is the only society that is confined to this group and the part they play in improving the economic health of Canada. I do not mean that from a medical point of view, because we are concerned with the economic and social development of Canada and how better we can use our national resources. Notice that I did not say "natural", but the national resources of Canada.

Also, microbiology, as we see it, has the opportunity, if properly developed, to play an increasing part in the economic development of Canada and the transformation that will occur in Canada within the next 20 or 25 years, whereby microbiology will be used and will take part in not only economic devel-

opment, but the social development of Canada as well.

You will note that we have been very careful in how we will transform our national resources through the use of micro-organisms and in the conservation and disposal of waste from industrial development and urbanization. We have stayed away from the use of the word "pollution".

The Chairman: Because it has been too polluted.

Dr. Eagles: In this way we constitute a unique body. We are members of the Biological Council of Canada, constituting a large group within that group. We support, as you will see, a diversified approach to science at every level and in regard to research institutes we do not necessarily mean buildings. We mean the provision of means, whereby people who are very diversified and group together will be used for *ad hoc* work problems. We are chiefly thinking in terms of *ad hoc* problems and how to get at a problem and then sometimes get rid of it and get on with something new. We refer to the Canadian post-doctoral program. We recognize that we already have one, but we think attention might be given to this, bringing together the various ideas of how we can do it from the point of view of the development of better teachers, scientists, research workers and how this can be brought together in order to increase the number of our own talents in Canada at every level.

We have a supporting group here that you may call upon, Mr. Chairman, with regard to any individual matter that you may wish to amplify.

The Chairman: Would you introduce them for the moment?

Dr. Eagles: We have Dr. Dempster from Saskatchewan, who is my successor as president of the society. We have Dr. Hinton from Queen's University, Dr. Frappier, Dr. Simpson from Saskatchewan and Dr. Martin.

Dr. Stevenson: Mr. Chairman, I should like to introduce the experts representing the Biological Council. First of all, we have Dr. Murphy of the Pharmacological Society, who has organized our group; Dr. Cook, recently head of biological science at the National Research Council and Past President of the Biological Council; Dr. Fisher, who is the commissioner

doing the survey for the biological sciences for the Science Secretariat; Dr. Gorham of the National Research Council, Dr. Munro, the entomologist, who will speak to the appended brief on behalf of entomology. Dr. Armstrong is from the Canadian Heart Foundation. Dr. Frappier might also like to speak for us, although he is really here with the microbiologists. Dr. Frappier, was Vice President of the Biological Council.

The Chairman: Thank you very much. We are all very pleased to have these distinguished representatives from the various societies. I hope this morning that we will have a kind of seminar and invite them to participate in our discussion at any stage they wish.

Senator Carter: May I ask this question right at the beginning, Mr. Chairman? How many of their membership are employed in industry and how many or what percentage, approximately, are in universities or in private—

The Chairman: Or in government work.

Senator Carter: Yes.

The Chairman: There are three main sectors that you want.

Dr. Stevenson: I think we might ask Dr. Fisher since he has been involved in the survey.

Dr. K. C. Fisher, Commissioner, Survey of Biology, Science Secretariat: These numbers should not be taken absolutely accurately, but the number of biologists employed in the federal and provincial governments together equal approximately the number employed in universities. These two groups together would compose perhaps 90 per cent of the biologists in the country. In order to understand when we are speaking about biologists, we are referring to project leaders, the people who will decide what research shall be done. This does not include graduate students or any technical assistants or technicians of any sort. It is the people who call the shots.

The Chairman: Since they call the shots, the figures or the distribution you are giving us would be reflected also among people who are behind them.

Dr. Fisher: Approximately, sir, yes. The number in industry is relatively small and as nearly as I can make out it probably is not

over 200. It would certainly be between 200 and 300, however, I think closer to 200.

Senator Sullivan: How does that compare to the United States and the United Kingdom?

Dr. Fisher: I am sorry, sir, I cannot give you that information directly. I could make a guess, however. The ratio of universities to federal and state governments is probably not very far from ours. I think probably—I should be glad to be corrected on this—that industry would be very much larger.

Senator Sullivan: In the United States?

Dr. Fisher: Yes. I am sorry, larger than in Canada, not larger than the other two combined.

The Chairman: I made a mistake in the beginning.

Senator Sullivan: I would have thought that biological research in industry in the United States is rather a large proportion.

Dr. Fisher: Yes.

Senator Sullivan: They are producing quite a few gases the Nevada desert and taking up a great deal of their time.

Mr. Chairman and honourable senators, as Dean Eagles stated, he is speaking for individual scientists. By reading the brief I find, even for a medical man, that some of the remarks are a little bit foreign. Dr. Stevenson, at the beginning of his statement, suggested that an agency responsible for funding biological research be formed under the National Research Council to avoid a proliferation of agencies. I like that remark and I wonder if he would enlarge on it a little, please.

Dr. Stevenson: Sir, the point is that the National Research Council has 21 members and only two of these are biologists. There is one medical man and this makes three out of a total of 21. One hears from the individual biological scientist that he does not feel he has enough representation at the top level, and therefore he suggests, not a completely new Crown agency, but, as the Medical Research Council was part of the National Research Council, that a Biological Research Council could be established within the NRC with sufficient autonomy that the public and Government could see what has been done for biology with it.

The Chairman: Why not the association with the Medical Research Council rather than the NRC?

Dr. Stevenson: Sir, I would ask one of the others to speak to this. I must make a confession that I am a medical man representing biologists. I am making this point simply to show that there is a tremendous intertwining. This happened to be the year a physiologist was made president of the Council. There is a tremendous inter-relationship. I would say that a great many of the individual scientists represented by the societies in the biological council are funded in their research primarily by the Medical Research Council, but also by the National Research Council and the other agencies.

There is this inter-relationship. It is extremely beneficial to the science, but it makes the administration at little complex.

The Chairman: There have been various suggestions made. Some would like to have a kind of broad council for the life sciences. Others, like the Macdonald study group, have suggested that we should have a health council. Now you come and you want to have a kind of subsidiary of the NRC for biology. I wonder if we could have some kind of general discussion, perhaps, of this.

The Chairman: Is there any additional comment on this?

Dr. W. H. Cook, Past President, Biological Council of Canada: This was a brief prepared, sir, before some of these reports you mentioned came before us and we did not have an opportunity to assess them. I think the general view of the Biological Council, when this was being prepared, was that the present system was not at all bad. As Dr. D'Iorio has said, biochemistry—which happens to be the discipline to which I belong—happens to be as close to chemistry, which is NRC, as it is to the medical side. It is somewhere in between.

The present system of funding material that is not strictly medical research and for the most part going on in medical faculties, is to finance it by the NRC.

I would not like to offer an opinion on behalf of the group here as to what their answer to the question would be, but it could possibly be associated with the Medical Research Council, although I believe medical associations throughout the world have preferred to remain relatively pure, shall we say.

Senator Sullivan: I think so.

Dr. Fisher: Mr. Chairman and honourable senators, I am from the University of Toronto and the Biological Council, and the Canadian Federation of Biological Societies. I am not a medical man. I am on the other side of the fence. I am impressed by how artificial, in a way, the border is between medical science, as we ordinarily use it in common language, and the rest of biology. One could, if one would, document a whole set of considerations which would make this point.

The last Nobel Prize, I think, or the next to last, was given to a man for work essentially on the giant axon of the squid. Without going into that, I might indicate that squid have nothing whatever to do with medicine. The fact that there was a giant axon that could be worked on would not have been known if it had not been that some zoologist had been working on that animal.

This kind of thing has happened time and time again. If one really intended to put all the power one could into the biology area, with the expectation of having an application to it, there could be no justification for picking out any given area to do this. One is just as likely to find something useful in agriculture, fishery, medicine or forestry, in one area as in another. There may be practical reasons why one must divide things up. But let us distinguish between what are good practical reasons, or good political reasons—one must have those too,—and what is a logical reason. I think there needs to be a closer twining of these things, if anything.

I think that the mechanism by which this is to be done is open to debate. At the present moment, it is certainly you, gentlemen, it seems to me, who are in the key position to decide what this shall be.

A further point I would like to mention is that when one is talking about the Medical Research Council and the National Research Council, we must not forget that we are talking about support to universities, and biology and medicine are very much wider than support to universities. So whatever device is thought about here, I would hope it would be a device which would look at the whole problem.

The federal Government is greatly involved in biological research, and it would be too bad, if in thinking of this, we do not provide some way of making all of this come to a

focus on what is necessary in our civilization today.

Senator Sullivan: Can that be done more perfectly in the MRC or the NRC area?

The Chairman: Or in an enlarged NRC?

Dr. D'Iorio: Although vice-chairman of the MRC, may I wear another hat?

The Chairman: We have been told there were all kinds of points of view, and various ways of approaching the problem—the political problem and also the logical one. We are expecting you this morning to deal mainly with the logical approach.

Senator Sullivan: Not the political.

Dr. D'Iorio: The only thing I want to say is that the impression one gets here is that the Medical Research Council has been rather narrow. It has arrived at conclusions which are not necessarily logical but were practical in awarding grants.

First of all, I must say that the Medical Research Council has in recent years expanded to the extent that it is really the health research council that is proposed by the MacDonald Report, because it already includes the dental faculties and schools for pharmacy throughout the country. So it is supporting the areas in medical schools, in dental schools and schools of pharmacy.

It is found extremely difficult, when dealing with projects coming from outside those three areas, to decide what to do with them. Normally, what they have done is that whenever a project comes from outside a medical school or the school of pharmacy or the school of dentistry, then it should be applicable to those three areas—otherwise the project it felt to be biological and is sent back to the National Research Council. As I say, this is a matter which is not absolutely logical, but it was a practical way of dealing with the problem. It is a problem that I think we have to recognize as such, and we are hoping very much that some conclusion will come out of the many reports you are receiving.

Senator Sullivan: Is that why it says on page 10 of your brief that you are recommending support for biochemical research and that all university departments be brought up to an adequate level, with a research institute of your own.

Dr. D'Iorio: A research institute of our own. I do not know that we said that in those

terms. However, the thing we were trying to stress is exactly this difference that, if you are a biochemist within a medical school—as I happen to be—then everything is considered through the Medical Research Council, and we know exactly what sort of level of fund we can expect, and so on. While, if you are a biochemist, outside the medical school, it is rather more difficult, it goes to the National Research Council and therefore the policies for funding, and so on, are quite different, and there is a different level altogether. We have made some comparison at some time, and the levels are quite different for support through the MRC or the NRC, and that is what we try to bring out in the brief.

Senator Sullivan: Thank you.

The Chairman: Can you give some indication of the difference?

Dr. D'Iorio: I would rather Dr. Fisher did that, because he has that in his own survey, which he has conducted.

Dr. Fisher: The difference is at least 50 per cent and closer to double; that is to say, biochemistry done in a laboratory of botany in relation to photosynthesis, let us say, receives support, typically, which is considerably less than that received for a project in a department in a medical faculty.

We would have to be a little more specific about this, if it became a matter of serious discussion.

The Chairman: We were told that apparently NRC and MRC were dealing with these applications in a different way, one presumably being more generous than the other.

Dr. Fisher: No. That is not so, sir. They are dealing with really a completely different set of applications. Typically, because it is a practical thing to do, the Medical Research Council has attempted to consign itself to people applying from a medical faculty. So this does not include botanists. On the other hand, the National Research Council does the reverse and picks up these other tag ends that are not otherwise covered. I suppose, if you come right down to it, it is simply a lack of money, but it comes out of this that the biochemistry in the one area gets supported only to about one half that in the other area. Yes, the biochemists have been drawing to the attention of all of us that this should be corrected, if it possibly can be.

Dr. D'Iorio: Mr. Chairman, if you consider all the biochemists, or at least the ones in our society, I would venture to say that 80 per cent of these biochemists are in medical schools. That is, the ones in universities; I am not talking about government agencies. Probably 80 per cent of them are in medical schools. So the Medical Research Council looks after most of the biochemists.

Dr. Eagles: Are you saying that 80 per cent of the biochemists in universities are in medical schools?

Dr. D'Iorio: I would think so.

Dr. Eagles: I would question that.

Dr. Fisher: We must be very careful, Mr. Chairman, what sort of emphasis we are putting on these things. For example, it is not universally true that departments of biochemistry in the legalistic sense are part of the faculties of medicine. There are several in the country which are in other faculties, such as arts and sciences, for instance. Some of the largest departments are of this sort. On the other hand, there is no doubt at all that the main emphasis of these biochemistry departments, and the reason for their existence in the first instance, is, certainly, service to medical schools. But, if one comes right down to the narrow legalistic sense, I think Dr. Eagles is perfectly correct that the number would not be as high as 80 per cent.

Dr. Eagles: Certainly, they are in the departments of forestry, agriculture, industrial microbiology and so on.

The Chairman: In fundamental research in faculties of science, too?

Dr. Eagles: Yes.

Dr. D. R. Whitaker, Vice-President, Canadian Biochemical Society: Mr. Chairman, I agree that the estimate of Dr. D'Iorio is high. But it is a difficult estimate to make in some respects, because it is difficult to draw a distinction between people in hospital labs and those in university labs. There are all sorts of inter-relationships between them. People in hospital research laboratories do have teaching appointments in universities. That adds to the total. But I think probably within our society a break-down would be something like this: we have about 90 student members working for their Ph.D.s. We have 510 professionals, 90 per cent of whom have their doctorate degree. The break-down would be: 300

in universities, 200 in industry, government and non-university-affiliated hospitals. Of that 300 in universities, I would guess two thirds are in medical school. That is just a guess. I am afraid we have no hard figures on that.

Dr. Eugene Munro, Entomological Society of Canada, Department of Agriculture: I would like to make three points that bear on the organization of grants for biology. First, because of the close association of biology in medicine, we very easily tend to fall into talking about biology and medicine as though this were the real application of biology. Of course, we all know that, traditionally, there have been two main areas of application, the medical field and the renewable resources field, which also is very important. We are now coming into a period where we have a third main area of application, that is, preservation of the environment, which is also important. Therefore, it would certainly be difficult to have a granting structure that was exclusively associated with the medical field.

The second point I would like to make is that we often hear it said that we know nearly enough science now and that what we need to do is to apply the science that we already know. I question whether this is really true in any area of science, but it is certainly least true in the biological area, where the basic knowledge is of an extremely complex kind and where only now, with the advent of computers, are we able to begin to approach some of the problems. Therefore, in a matter of financial support for biology, it is very important that the basic components be continued to be equally represented.

The third point I would like to make is a personal point of view, but I think it is a fairly important one. I think it would be very dangerous, if we got into a granting structure so logical or so well organized that every scientist was automatically channeled to a particular granting board. It is a fundamental principle of granting that every scientist should automatically have at least two places to go.

The Chairman: Yes. I understand that confusion may be desirable up to a certain point, but it seems to me that we should not try to maximize it, however.

Senator Sullivan: Mr. Chairman, I have one question to ask Dean Eagles. My association with Dean Eagles goes back many years. I think he made the statement that I was not

quite clear in my understanding of what Dr. D'Iorio had said. Dean Eagles on page 6 of his brief said that there should also be governmental support of a few specialized institutes of microbiology. Are there not any now?

Dr. Eagles: The sense in which this was written was not by any means in the physical sense. It was the idea that, where problems arise requiring the expertise of a great diversity of people, there could be a means whereby these people could be brought together to work together and to discharge their obligations, and it would constitute an institute. This was the concept. Flexibility is what we had in mind.

Senator Sullivan: I see.

Dr. Armand Frappier, Director, Institut De Microbiologie, Université de Montréal: With your permission, Mr. Chairman, first I would like to say that questions have been put to me in the past, by some friends, asking me whether I believed in microbiology and in microbes. We have first to believe in the microbe and then to believe and persuade others that, in dealing with the microbe, the avoidance of bringing microbes into the manufacture of materials is very important. We can make use of microbes for all sorts of purposes, preventive medicine, industry, agriculture, and so on.

Microbiology is a multi-disciplinary and multi-professional discipline by definition. You find the services of agronomists as well as biochemists and other disciplines linked with the study of microbes for use in preventive medicine and industry. Therefore this very important spectrum of the use of microbes either for medicine or for industry or pharmacy or agriculture and so on brings the necessity at a certain point to study in depth the problems that need an answer in the relatively short-term period, and these institutes of microbiology in the world have shown that they can fill that role.

Microbiology, of course, was first applied to preventive medicine, but now microbiology has reached the stage in a country like Canada when, I am convinced, with the use of microbiological methods and the knowledge we have of microbes and their scientific derivatives we can economically accomplish certain developments, and if we use less crude methods such as chemical methods that would be costly and difficult much can be realized. For example at the present time in

the Province of Quebec, and I think this is a national problem, we are thinking about the situation in Canada so far as our forest industry is concerned if a synthetic process were developed for making paper. We face this problem with the Canadian Pulp and Paper Laboratory, and we found that the main problem in the attack on wood by microbes is the lignin and when the time comes that that problem is settled, it will be more or less as a result of long-term research. This kind of work can be done in university laboratories as well as in private or specialized institutes.

But there are some other problems facing industry such as problems related to trial and error research in new antibiotics and new drugs against cancer, or anti-viral drugs. Industry is seeking association with that kind of institute in order to have Canada play a role in the development of such products. That is not a long-term approach. Another example of the shorter-term approach to research is the recent development of a serum used in transplants. The use in large quantities of horses and the major chemical developments for purifying these serums and the necessity of carrying out these techniques quickly is the result of work done by such institutes as the Connaught Laboratories and the Institute of Microbiology who had the set up ready to answer the call of the National Research Council and of physicians and surgeons to do research into the nature of this and to make this material available on a pilot-plan basis and later, maybe, on an industrial-plan basis. So these institutes are dealing with the problems that have a short-term or long-term aspect, and I think they can render great service in a country like Canada not only in such fields as preventive medicine, but also in industry and in the economic aspect of agriculture and so on.

The Chairman: Thank you.

Senator Sullivan: I was not being critical; I just wanted to bring out the point of necessity.

The Chairman: Who is going to continue this discussion?

Dr. Norman Hinton, Chairman, Department of Biology, Queen's University: The discussion we had about the funding agency, the MRC and the NRC, has been at the top level and I wondered if I could lower the tenor of this discussion to the point of view of the

scientist working at the bench. You see, what concerns us here is the man and his productivity down at bench level and it is important for us to get some idea of how he feels things should work. Let me give you an illustration. In a university such a person is employed to teach and to do research, both of which demand quality of the man. His hard funding is his salary, his office and what he needs to teach, and traditionally everything else has been left to outside agencies to support. Now basically I do not think any of us complain about that; we think it is right to apply to agencies for the money and to have to give effective arguments to demonstrate the need for the money we get. We think it is also right to demonstrate productivity to justify this money, but I think it is worth recognizing that the average scientist in this country starts the beginning of the year with a zero hard budget. He does not have any base line. I do not mind writing to MRC and saying "I need 3 electro-microscopes and they will cost \$100,000." Then I will set out my reasons. Because here I have reached a qualified stage, and I have reached an understanding with my peers. But when I have to apply for \$100 every year, it is a different matter. Is there no base-line approach over which I may have to apply for money for my work? I think the average scientist spends a lot of time on what I would call grantsmanship. That is in devising ways of obtaining money. He spends a lot of time in the preparation of reports and trying to find out what the attitude of a particular agency is. But that time could be spent better in doing the work he has to do.

Another point I would bring to your attention is that the scientist is often accused of having a very narrow interest, strictly within his own sphere, and of not being interested, at the level of this work, in the problems of the country. A lot of his narrowness is related to the way he gets his money, "You had better be expert if you want to get support." The way to be expert is to know a lot about something. You have to be narrow in order to acquire your expertise. The scientist is trained as a problem solver, and it is not necessarily restricted to something he knows much about, but give him a problem to solve and he is going to have a good bash at it. People rarely come to the scientific community and say, "Here is a problem we think is important, and as a country we need to solve it. You have the expertise in problem solving. Will you get on with it?" He has to prepare

some kind of application and argue somebody into believing it is right, organize the money, and then he is allowed to work on it. I think it is a very cumbersome device, and it is one that speaks for the inefficiency of what we have, which is a pretty sophisticated scientific process, and I do not think it is allowed to operate very efficiently.

The Chairman: We were led to believe, by some people at least, that researchers and scientists in universities wanted to retain that kind of exclusive right to apply first and have granting bodies at the national level being more or less passive and waiting to receive applications. I am very glad to see that this point of view is not universally held.

Dr. Fisher: I am in the position of saying I agree with this. I think it is important it be understood there is a large body of opinion on this point. There is a middle area here. I do not think anybody could possibly take exception to the idea there should be available in each university, let us say, an automatic base line support. However, it is a curious thing that among our colleagues we find a fair number who feel that they need, as an individual approach, an extra body right outside their institution. So I think it would have to be paid for, if you wish to maintain it, and I think Dr. Hinton agrees with this.

The Chairman: This is a point of view we have not heard presented very often to us from the universities.

Senator Belisle: Do you have any knowledge that in the foreseeable future—let us say, within 10 years—you will have a by-product that will replace pulp, just as synthetic rubber is replacing rubber, which will be marketable at an economic price?

The Chairman: We hope not!

Dr. Frappier: What I mean to say is there is confidence that microbiological methods are economic methods and could be applied even in the bush. It is our hope that they may solve the problem of the use of wood, at least to a certain extent. If they have not yet, it is for that reason, that very few microbes have been found to have some effect on the lignin, but that does not mean that there are none that could attack it. There may be some improvement of their action made genetically in order to make them more active, and we have the testimony of many learned men and that of the pulp and paper industry who are

encouraging the Institute of Microbiology to go into this field to find future uses for wood, and this is a very serious problem.

The Chairman: We are trying to prepare ourselves, just in case other scientists succeed in finding a substitute for wood to produce paper.

Dr. Frappier: We have no chemical industry in Canada, or very little, but we may develop some of our own, through microbiology.

Coming back to the inclusion of biology in the Medical Research Council, you have an example right there. Physicians may be somewhat interested in this problem we are speaking of, but they are very far from the problem. However, the National Research Council is very much interested in this, and so a Biological Council might consider a problem like the above and give some priority to it. It is more likely it would be a question for the National Research Council than the Medical Research Council. So, an institute of microbiology would have to apply to a body more interested in that field than medicine may be.

Senator Phillips (Prince): May I ask a question along the lines of the question that Senator Belisle asked? Can you give us any information on the use of microbiology in mining, Dr. Frappier?

Dr. Frappier: Yes, we have also this aspect of microbiology. The Polytechnic School of Montreal has discussed with a small panel the treatment of ore—sulphurated copper and iron ore. There are already microbiological methods to treat the ore in order to extract ore from sulphur material in an economic way and to reduce its volume so making transportation easier. There is a manufacturer in France who has started up recently the making of artificial manure. I am a physician and I am not concerned with agriculture, but now the specialists are very much worried about the shortage of manure, and certain agriculturalists do not like the exclusive use of chemical fertilizers, so they are now attempting to make manure out of rubbish; they also make it out of grape seeds. We can make it out of wood also, and that is another point. Regarding the use of petrol, when petrol is present in small quantities it cannot be extracted economically for mechanical utilization, but it can be used for the production of artificial protein, and there is another indus-

ry in Europe, that has recently opened up, which is manufacturing protein out of petrol.

The Chairman: Apparently, there the problem is to make it edible. Give them some kind of flavour.

Dr. Frappier: They have succeeded in removing the flavour.

Dr. Eagles: I would just like to add a comment to what Dr. Frappier has said about the question concerning the use of micro-organisms in the leaching process of ores. There happens to be in British Columbia an example whereby the British Columbia Research Council is working with the leaching of ores, as you probably know. That group in that council corresponds to the type of institute we have in mind in our brief, whereby it brings together a diversified group to study this problem, engineers, microbiologists, and so on, and you get them working together.

Senator Phillips (Prince): And that is what you mean by taking a greater part in the economic development of Canada?

Dr. Eagles: Yes.

Senator Carter: Along the same line, what is being done in Canada to convert waste? Waste is becoming a problem—garbage, and so on. What is being done to convert it to usable forms? Is anything being done in Canada on that?

Dr. P. R. Gorham (Representative to the Biological Council of Canada of The Canadian Society of Plant Physiologists): There is work going on at the Ontario Water Resources Commission and interested agencies concerned with waste disposal and pollution. Quite a bit of work has gone on in Europe, say, utilizing sludge from sewage digesters and garbage disposal by composting. So, there are some studies, but they are of a preliminary nature.

Senator Cameron: Mr. Chairman, is it not true that a project has been developed in Detroit for the utilization of sewage disposal to make fertilizer and things like that?

Dr. Gorham: Detroit?

Senator Cameron: Yes.

Dr. Gorham: Yes, there is work of this kind. I would not say that there is any active work that I am aware of in Canada at the

moment. There has been a lot of work done in the United States and Europe in the past. Most of this can be applied, if it is suitable to your immediate problems.

Senator Cameron: It seems to me that the Resources for Tomorrow Conference in Montreal two or three years ago had a paper on this. Samples of the product were on display there.

Dr. S. M. Martin, Canadian Society of Microbiologists: I suspect that most of the gardeners in the group used such products as come from a sewage plant in Milwaukee. I think that a few years ago Toronto also had a product on the market. I am not sure whether it is still available. The Milwaukee product, of course, is one of the better known ones. With respect to garbage, there has been some work done in California fairly recently with respect to compost garbage, to make an artificial manure, shall we say. This apparently looks like a very profitable operation.

Senator Cameron: Mr. Chairman, one thing that I think must impress the committee and anybody who is observing it is the quality of resources that we have in Canada in the scientific field. This morning's panel is a very good illustration of that, but the very fact that there is such a diversity of approaches is one of the problems that we have to deal with in trying to formulate a national science policy.

I would like to know from Dr. Fisher how extensive his terms of reference are in, first, getting an over-view of the total resources of manpower in the field of biochemistry in Canada? Secondly, an over-view of the total picture of what is going on in the field of biochemistry in Canada, again coming back to my national inventory. Thirdly, what is the present funding for the existing programs?

Everyone here is saying the federal Government should fund this and fund that, but there is very little co-ordination amongst them. Somebody among this scientific community has to come up with some pretty good answers in terms of the national over-view. Is this what you are trying to do and, if not, who is doing it?

Dr. Fisher: This is a very fundamental point, senator. I hesitate to answer it; you have asked a very large question. I should say immediately that it is not merely a matter

of biochemistry; it involves biochemistry and microbiology amongst other things.

Senator Cameron: It is an inclusive question.

Dr. Fisher: It is a tremendously important one and there are many people who think this is the most important thing that lies ahead of us. As far as my terms of reference are concerned, they permit me to look at this, but I do not have the facilities that this group has and I cannot call, for example, on Government departments to give me the detail which has been possible for you to have. Accordingly, in some measure I do not have so much information as you do, but at the same time there are no holds on me to prevent me from asking people about these things. You have to realize that in this survey it becomes rather personal. Although I have 70 people working for me, it becomes difficult to come to a consensus. So I suppose you must discount it on these grounds. In the first place, it is my impression that there is nobody in Canada at the moment—I am bending over backwards to make the point—if you said there was nobody I am sure I would dig up somebody to counter the argument. I am rather impressed with how little planning we have done. I think we would have to be a little careful; I do not think we should immediately come to the conclusion that we as Canadians are slipping in this connection. There are lots of places in all countries in the world where this goes on; planning is a difficult thing. You can defeat the very object which you are attempting to accomplish with all these provisions. I still believe that we are not doing as much planning on all these things as we ought to be doing. I do not believe that the people who must run our Government, you gentlemen and others, have been able to get into and think about this as much as possible. You could not do it alone. I think scientists have to point out what can be done and then it would be up to the political system to find out what we should attempt to do, probably with some advice from outside. Scientists cannot have their way, I insist upon this, but they can be useful, I am sure, if they are brought into the picture.

One of the things that was in my mind a moment ago was that in support of biology you must remember that it is not merely a matter of supporting biology in universities. Real efforts have got to be made to co-ordinate this business so that some of these things

do not fall into a morass of no importance at all. On this matter of looking at sewage, understanding what the whole circumstances are, there are people who know more about this than I, I am sure. I have been present at some discussions and the principal hold-back here is a clear mandate. A university man, by and large, could not afford to pick this up, for any one of a dozen reasons. In the first place, you cannot possibly see a quick solution to most of these things. Most of us would insist that there is a solution, but we cannot see a quick solution. Therefore it does not fit into, if I can put it this way, the university setup unless there are special circumstances involved. This is why I like a kind of contract research in this area. I like it from two standpoints: In the first place, it gives the man assured support over a period of time, which no granting system in existence does at the present time. This is necessary if you are going to get anything like this done in a long term operation. Secondly, it keeps the researcher's mind on the object of the exercise. This is not to replace grants; it is a complement to grants. I think we have got a great deal of capability, without hurting anybody or making anybody feel that they are being constrained, that they can contribute more adequately to it than all our grants.

Senator Cameron: He has answered a little bit, but he has left a tremendous amount unanswered. This is what worries me, because if a group like this is not providing the answers, then what can we do?

The Chairman: Senator Cameron, I always understood that our operation as a special committee of the Senate was for the first time to try to look at this in an overall way. Since we are still in the process of learning as members of this committee, I think the members of the scientific community are also more or less in the same phase of trying to learn, so we are learning together. I do not think we will be able in two or three months to discover final answers to these very complex issues. That is why yesterday afternoon before the Royal Society of Canada I was pleading to see developed in Canada a love affair between the scientists and the politicians, which is perhaps beginning this morning.

Senator Cameron: I will go along with that.

Dr. Fisher: We like love affairs.

Senator Phillips (Prince): We have not passed the amendments to the Criminal Code yet.

The Chairman: This is probably the only love affair senators can have.

Senator Robichaud: Are you speaking for all of us?

The Chairman: I, of course, exclude Senator Kinnear from this.

Senator Grosart: Pursuing that point, I might say that for a long time the Commons had what was called the Committee on External Affairs, while the comparable Senate committee was called the Senate Committee on External Relations, on the ground that affairs should not concern senators. The name has now been changed to Standing Senate Committee on Foreign Affairs, so we are back in the race.

The Chairman: But it is foreign to the Senate.

Senator Grosart: At our age do we have much choice?

I wanted to make some comments following the line of Senator Cameron's questions. First of all, I should like to compliment the Biological Council of Canada on their brief. To indulge in a comparison with the others might be odious, because something of what I have to say about that brief applies very definitely to the others. However, it is specifically noticeable in the brief presented by the Biological Council of Canada that there is an attempt to give some of the answers for which Senator Cameron is asking. As far as I know, this is the first brief presented to us containing a section headed "Policy", which discusses in considerable detail what a national science policy should be. Furthermore, this is one of the few briefs, if not the only brief, we have had that attempts to assess the dimensions of the future funding requirements of the disciplines concerned, with some attempt to relate those requirements to the total overall picture of federal funding of science in Canada—if we can ever discover what "science" is and what its dimensions are.

The figures given here are not very clear. For example, in what is called the abstract to the brief I read:

In Canada life science receives only one-third of federal research funds while

comparable federal agencies in the U.S. assign over half their funds to this field.

I suggest that that is a bit misleading because of the use of the word "comparable", which is not here defined. It is almost impossible to say what are comparable funding agencies. Obviously, if you take in the total United States figures—that is the AEC, NASA and the Department of Defence, which account for probably 80 per cent of all funding in the United States—you have a very different picture. In other words, you come up with something like in Canada where it is a third in Canada and in the United States it is about a quarter. This is discussed on page 9. The point is made, but I think the bald statement in the abstract could be misleading. Now, arising from those two comparatives, whether it is 50 per cent of the United States funding, going into the life sciences or a quarter which I think is a more accurate figure and a third in Canada, is there anybody here who will attest to the validity of a third or whatever it should be, as adequate or inadequate in this context and to validate it in terms of the total federal funding of science. Why should the life sciences get a third or a quarter or a half or three-quarters? This is an essential problem to this committee because we are going to have to recommend some kind of a mechanism that will be of some use to the political decision makers.

Dr. Cook: You realize, of course, that there are no absolute standards, as you have mentioned. It has been common practice to assess Canadian expenditures for research and to compare them to the United States, the United Kingdom and so forth. We have taken this breakdown here on somewhat the same basis. I will attempt to answer the question.

In the United States the comparable agencies—I believe we have cleared that point. We did not think we could compare the terrific NASA expenditures, DOD expenditures and AEC and make a valid comparison.

Senator Grosart: Would you let me interrupt. I am thinking, of course, in terms of federal funding, because one of the questions that we are going to have to answer is "how much" totally. This is a figure that a politician must have if he is going to make a reasonable decision in comparing this with all the other claims on public funds. Therefore, I am taking the total American expenditure on public funds and for our purposes it is the best base for comparison.

Dr. Cook: As you have said, this is a political decision as to how much money will be agreed upon by yourselves and how much Parliament should be spending on research. We are only dealing with the proportions here. If you feel it is more comparable to include all federal expenditures, which we have no counterpart then, of course, the ratio becomes entirely different. It is a quarter or double if you compare it to about 56 per cent. If you take the things we are dealing with in this brief and compare them to the Canadian situation, why 50 per cent or why should it be higher than a third—that is your other question.

I would like to present the point of view. We have the comparison with the United States, whether you consider it valid or not. We are, today, thinking of a great deal, such as expenditures for research that will eventually increase our wonderful GNP. We all realize that we must earn dollars, however, in the fiscal sciences a great deal is being spent on industrial research that is, in many other ways, being subsidized by the Government. What about the aircraft industry? In the biological sciences we have problems untouched. You have heard Dr. Fisher's statement, which is stated in this report, that industry makes a very small contribution to research in the biological sciences. It is true that the Government has led a number of incentive plans and I think these have worked very well on this limited level, but relative to bringing industry to research it is like giving aspirin tablets for a headache without finding out the reason. My contention is that if the United States Government for NASA and these other agencies can spend a great deal for research in industry on a cost plus basis, could we not clear some of our social problems by the same procedure, which I think is recommended directly or not so directly by the Science Council? Here is one way of tackling the pollution problem at the industrial level. I think if one thinks in this way, and this is perhaps biased biological thinking, Canada could increase the proportion of the total research expenditure which will be for you people to decide in the life sciences.

It has an economic aspect, but I will also admit it has a great social aspect. Are we trying to maintain our environment and increase the quality of life for Canadians or is it only the GNP we are interested in. I do not know if I have answered your question.

Senator Grosart: Perhaps I can put my question in another way which might make it a little more explicit. You define your role in the science and technology picture as in the middle between the social sciences on the one hand, and the physical sciences on the other. Let us say that you are a third in this sense. Have you looked at or has anyone looked at the comparative requirements of the three sectors, each of which will be before us, no doubt, to say: "Here is why we should have more than a third." This is the point that becomes emphatic over and over again in our own thinking, because we have to recommend a mechanism that will come up with this kind of decision. Why more than a third for one of the three large components?

Dr. Cook: I shall only give a personal opinion. I know that in our discussions, when this brief was drafted, that there was a strong feeling in connection with the urban problems that will arise. The forecast is to be some 35 million Canadians 20 years from now and most of them will be living in urban areas. There was just as much regard for getting the social sciences working on this problem along with biologists and engineers. It was recognized that this was a very broad interdisciplinary field.

If we are going to solve the problem we cannot do it entirely with the material sciences or the physical sciences. We cannot do it entirely with biological sciences and while we took no explicit statement on this, since it was outside our field, I am quite sure the members of the Biological Council of Canada would support a very substantial increase in the social sciences and indeed the humanities. They are very low now, as you will agree. I do not know how you can prime the pump and get competent personnel to deal with it. This is probably one of the most important problems before you, but outside of the field of the Biological Council—

Senator Grosart: Let us say that if each of the three sectors that I have described a minute ago came up with recommendations which boiled down to this, that each one thought he should have 50 per cent. Can you suggest the kind of mechanism that might arbitrate these choices and that would be reasonably satisfactory to the science community?

Dr. Stevenson: If I may speak to that. I think this is the point that was made in our brief, sir, that we do not know the answer to

all of these questions and this is why we want to see the Senate continue its committee. We want to see some preliminary recommendations come out and suggestions from the Senate and other fields of Government and allow the scientific community of Canada to respond to the citizens who do not have an overall view of social science and so forth. We do not have an overall view of science, social science and so forth. This is the first time scientists, elected by their peers, have ever been asked to relate to the Government as citizens.

I would suggest that you have to be willing to allow two or three years to elapse, at least, to let your operation have its fruits.

Senator Grosart: The difficulty there is that we would be three or four more years in known imbalance, waste, overlapping, lack of co-ordination, and so on. I do not think a committee such as this can take that responsibility. We must ask you to give us your advice on these matters, and looking at the critical consequences on the responses to the Macdonald study group report, we would hope that we would be able to come up with a report saying, this is what the science community wants, it makes political sense, let nobody criticize it.

The Chairman: I am sure there would be a few critics, just the same, and I am sure you would be amongst them.

Senator Grosart: My point is that we have to extract all the advice and all the information that we possibly can from gentlemen like yourselves who are good enough to come here and give us your time. That is why our questions at times may appear to be provocative. That is because we are getting a bit frustrated, particularly when the one "policy" that is proposed over and over again is "give us more money, more political money, but less political control." Everyone wants more money. That is understandable. But this is a case where someone has to come up with a total figure that makes sense in relation to all the claims on the budget and one must come up with some kind of consensus as to how that should be divided.

The Chairman: Before you go on, senator, would there be some agreement here on the assertion that we see very often, that biology in all its various specialized disciplines related to it, is the scientific field which is most likely to make more progress in the coming years as compared to other disciplines?

Dr. Fisher: I was going to remark that even the atomic scientists in the United States, some of the important ones there, are already on record that it is in the broad field of biology now where one can expect the greatest advances and the greatest impact on our civilization in the next few years. This is not a very precise statement, but there it is.

Dr. Hinton: The trouble is that we are often asked this question, sir. It is a sensible question but then surely we must recognize it is not possible to answer it. How much money? What proportion of such money can you justify for a given area? One recognizes that scientific research is an open-ended proposition. It is possible to spend unlimited amounts of money, to whatever conception you like. As far as justification is concerned, surely to goodness all of us believe that what we are working on is worth working on? In the medical field you recognize this and deal with this politically.

It would be theoretically possible to spend as much money as possible on the health care of the nation. That does not answer the question, but it is necessarily the only answer. How can I give another answer? If there is one sick child who needs to be looked after, how can one argue that it is not worth spending money to deal with that child? Therefore, the amounts are unlimited.

The question the scientist is not asked is the one question he is competent to answer. If I am working in a particular area and you give me \$5,000 and you ask me what I can do with it, I can tell you. I can give you this answer. If you ask a physician in practice what he can do, he can tell you. You have to add up all these things and then decide if it is enough or if it needs more. But to ask a scientist whether he has enough money to spend on the biochemistry of enzymes functioning in the liver, is a question to which his only answer can be "No, there are many important things to do yet in that field". I think we ought to ask the scientist the other question, what can you do with what you get, and see if that adds up to the overall amount that the country can provide.

Senator Grosart: I was not suggesting for one minute that the implication of the question was as you suggest. You say it is impossible to get the answer. The fact is that the answers are being given every day.

The Chairman: Which is, as you know, the essence of politics.

Senator Grosart: There exists now the imbalance, or whatever it is, that we have as a result of our national science policy, such as it is. It may be fragmented, it may be uncoordinated, but the answers are being given, because politicians have to determine these things as they come up on the estimates once a year.

What I am asking is that the science community help in determining the input of the relative money values in terms of the annual estimates of the various needs of science.

Now, to whom else can we go but to the scientist? The scientist naturally objects to what is called the ivory tower concept of politicians, who more often than not dispose of the problems, as is often claimed, by merely cutting everybody 30 per cent. This is not a scientific approach. This is why I am insisting that we must get these answers from scientists.

Mr. Chairman, this is implicit in the policy statement from these gentlemen and I hope you will allow me to read into the record three paragraphs which, to my mind, are the best piece of thinking and writing that I have seen on this whole question of policy. That is why I would like to take these paragraphs out of the brief and have them appear in the record at this point. May I do that?

This is from page 10, headed "Policy":

There has been a tendency to discuss science policy either entirely in relation to economic and social goals, or as an end in itself unrelated to national objectives.

This reflects the two kinds of decisions required in formulating policy, namely, the role of science in advancing broader goals, and the support of pure science solely as a contribution to knowledge. While these two scientific objections are interdependent their relative magnitude will be determined by somewhat different considerations.

I may interject, this is the whole point, that you have got two sets of decision values, one for each of these categories, and the two categories are these:

For advancing economic and social objectives, the first step is to define national goals and this is a political decision that must be based on much broader considerations than science alone. Such goals must be assessed in terms of public benefit, the probability of success at all

levels (scientific, industrial, social etc.) and the resources available for their accomplishment. A scientific solution is not enough, as failure at any other level would mean that the scientific effort would be largely wasted.

And then the second approach is:

The scope and kind of scientific effort required will depend on the objective and this is largely a scientific decision. Again, the available resources may have to be focussed on a limited number of objectives. This will require priorities based on both political and scientific decisions. When these decisions are taken, research and development costs can be estimated without assuming that they be some arbitrary percentage of the GNP.

I have some reservations about the last sentence, but there it is. How do we get the input of science into each of these categories of decision-making, so that we can get what you describe on page 17 as a mechanism "for a meaningful dialogue between practising scientists and Parliament."

I have some other questions, but I will leave it at that for now.

Dr. Stevenson: If one may try to answer that, the point is that for the past year biological scientists of Canada have been conducting a survey in the department. Unfortunately the results will not be available until next month owing to some problems with the computer systems. After the results are available, we will be able to make much better estimates of what it is costing for various biological programs and what they are producing in Canada.

When politicians representing the people decide on those biological problems they want solved and emphasize them, we will be able from this earlier data to give more realistic estimates of what this or that will cost. It is not always a matter of a percentage of the gross national product, although that is one good criterion. It is often a question of how badly the Canadian people want to solve certain problems facing them in the fields of health or biology, and it is also often a question of how much they want to pay to solve those problems.

In a few months' time we will be able to answer such questions more realistically, because the results of this huge survey that went into great depths will be available.

Senator Grosart: I am not being critical of the fact that you have not got the answers today, but on the gross national product aspect, perhaps I can just comment that, if the percentage of R & D funding by the federal Government at the present time is inadequate, as seems to be generally agreed, then surely part of the fault lies with the science community for not persuading politicians that the percentage of GNP directed to the funding of R & D is not sufficient.

Dr. Stevenson: Well, sir, there might be one answer to that.

Senator Grosart: I said part of the fault.

Dr. Stevenson: Scientists have not done this. In a sense that may be a fair criticism, but I will point out to you that until the Senate established this committee there was really no channel for, so to speak, the elected scientists representing their peers to speak at this level. We have had excellent organizations, crown organizations, NRC and MRC and so forth, but these bodies, let us be quite fair about this, are appointed by the crown and are responsible to them to carry out policy, to advise them, and, in all fairness, to advise them in confidence often. That is their duty. I don't object to it, as a citizen.

It is for these reasons that we are so pleased that the Senate has opened this channel so that these things can be dealt with. It is difficult for a member of the Medical Research Council, for example—and I am not one, although I know many—it is difficult for him to criticize his council publicly. There is a conflict of interest there. I don't expect the council members to criticize their council publicly. That is why we feel this committee serves right now, and, if it continues, will serve, this very excellent purpose; in fact, it has already stimulated scientists to look at themselves as citizens.

Senator Phillips (Prince): You said, "if it continues". I take it, Dr. Stevenson, from your earlier remarks, that you would like to see it continue.

Dr. Stevenson: Very much so, sir. The "if", sir, is that you are the Senate; I am not.

Dr. Fisher: Mr. Chairman, I am willing to stick my neck out on a figure to indicate the kind of decisions that could be taken but, again, for which there has been no machinery. There was a suggestion in the newspa-

pers that there might be an expenditure of \$150 million for a piece of physics equipment. Just for the sake of argument, let us suppose that 10 per cent of this was available per year for ten years. I can say unequivocally at this moment that that amount of \$15 million a year added to the biology sector of the National Research Council would revolutionize biological support in Canada.

But there has been no forum. However, do understand me. If the physicists were sitting down with us, I would not be too surprised if they were to agree with this instantly. But the point is that they have not been required to do so. They have not been given the responsibility of the broader view. Their responsibility has been to present the physics case just as we are presenting the biology case this morning. Somehow or other there is a need for some kind of machinery to fix on all of us, as citizens, the responsibility for scientific decisions of this sort.

Dr. Munro: Mr. Chairman, I don't know the answer to Senator Grosart's question, but I had the good fortune to spend a period with the Science Secretariat and I spent a certain amount of time thinking about the answers and listening to the thoughts of other people on the answers.

I am not convinced that anybody knows how to assign these priorities on a macro-level. Part of the reason is that we are not talking just about priorities within an isolated thing that we call science expenditures and science policy, but that these are things that interact with our whole expenditures, whole activities, whether they are directly reflected in expenditures or not.

So while the whole picture is something we are trying to arrive at and we have to keep it in mind—and indeed practising politicians and people in government will have a kind of insight and experience in how to approach these things—nonetheless, when you are trying to determine these priorities you are really determining them piecemeal in relation to particular problems and not just in relation to specific scientific problems but in relation to specific problems, generally.

If you are talking about biological research, you are talking at one time about things that bear on medical problems and you are talking at another time about things that bear on forestry problems and so on.

In each of these areas and in each of the places where expenditures are made and

priority decisions are being made, they are being made by more or less appropriate mechanisms, but by mechanisms that have been developed over time.

This, I think, is right and proper. The problem of science policy is: does the whole picture make sense? Well, to one degree it can only make sense to the extent that your general arrangements make sense. If your organisms for dealing with forestry, with education, with cultural development make sense, if the interests of people are properly expressed in effective societies, effective political institutions, then the general structure will make sense and the parts put together will make a degree of sense.

The problem then, in looking at the whole picture, is whether the quantity is out of line with what we can afford in a particular year or in ten years. This is basically a political decision.

Secondly, is anything significantly distorted or left out that we ought to be doing? Here is something where we have a social and political input on the one side and where you can see that there is a national demand for things to be done, and this is one of the things that is moving science policy today.

On the other hand, a scientist may tell you that such and such a thing is possible or that such and such a thing is an area that we don't know enough about and that we have to explore. A scientist can make another kind of comparison, as Dr. Fisher has just done; he can say, if you want to get pieces of data in one kind of science, it will take such and such an organization and it will cost X dollars; if you want it in another kind of science, it will cost more or less.

He can tell you that the scope of the unknown in a particular area is greater or that we have more possibilities at this stage of penetrating it than we have in some other area.

Scientists have not been very good at this thing, and I think this is where a good deal of the difficulty over dialogue has arisen; we have not tried to put the art of our scientific problem into perspective of why this is important and in what area it is important, and I do not exclude the contribution to the pool of general human knowledge or to the knowledge at the disposal of the average man which has had a very great influence on our reaction to things in the last period of years.

Now, I do not pretend to be an economist, but I am told that economists recognize the level of education of the population as being one of the big things influencing the level of productivity of the country. But to build out of the piecemeal and then see what is missing and to see if this or that is out of proportion seems to me to be the only approach.

Senator Grosart: This is on the upgrade, but I just want to draw to your attention this aspect of the problem; I am sure that the science community generally in the United States does not agree that nearly all, (I have forgotten the percentage now, but it is nearly 80 per cent) of the total funding of R. & D. goes into those three agencies, AEC, NASA and DOD. If the same political decision was made in Canada, the science community would not be very happy. Somebody could decide that we should join in the moon exploit and make out a political case for it.

Dr. Munro: It is not, sir, a unilateral decision, but it is primarily a political decision leavened by the experience by what is feasible.

Senator Grosart: Well I do not see how anybody could regard these decisions with regard to AEC, NASA and DOD as being anything but political decisions.

Dr. Stevenson: Mr. Chairman, could we consider asking Senator Grosart to consider correcting one of his remarks. He said "if we would ask for more money and less political control..." I feel the second part of his remark is not from our records, sir. I think the Canadian scientists are rather proud of the fact that their community has not tried to exercise any direct political control and I think, as a matter of fact, in our brief we ask for a challenge from the politicians representing the needs of the country. In fact we are rather pleased at the way our governments have handled science in terms of freedom and so forth.

Senator Grosart: I will be very glad to make the correction in relation to today's hearing. I am still reeling from the impact of the presentations made by the universities of Canada.

Senator Cameron: Mr. Chairman, one of the things which concerns this committee very seriously is the question of the mechanisms for the translating of the needs, the scientific needs of the country, into political decision-

making and I was very interested in the abstract from your brief where you suggest some of the mechanisms. Before I read that paragraph, let me say I agree with Senator Grosart that this is an excellent brief and it gets down to some of the fundamentals we are concerned with. The B.C.C. recommends that the Privy Council Committee for Scientific and Industrial Research become the political entity for formulating science policy, and that its chairman be a minister without other government departmental responsibilities. In other words you are suggesting a minister of science, which is a controversial subject. Can we take it as a committee of the Senate, that this group representing the biological sciences and microbiology are unanimously in favour of the establishment of a ministry of science?

Dr. Stevenson: I do not think so, sir. We mentioned a minister, not a ministry. There is the feeling that there should be somebody at cabinet level who can speak in cabinet on science. But I think that other than that individual, with the very minimum of secretarial help, it would be far better for him to derive from the agencies—it is more that there should be an individual who is thinking about this at the topmost political level, but I think that the majority of scientists both in the B.C.C. and in other places would at this time at any rate be against a ministry of science as a monolithic organization. This is an important distinction to us.

Senator Cameron: As between a minister and a ministry; but supposing this committee were to recommend the establishment of the position of minister of science, we have had a number of suggestions that there be under this umbrella a series of institutes of various kinds to deal with the specific areas of the scientific field.

Dr. Stevenson: Well, I think, sir, that this is a matter for political decision in terms, first of all, of the problems that the country wants solved. I think you have to deal with this at two levels, as was mentioned earlier by Dr. Hinton. You have to give a certain amount of basic help to research to keep your pool of personnel and your pool of ideas available right across the country. And, with all respect to the BNA Act, sir, you cannot separate research from advanced education; they go hand in hand. So you have to decide what you want to do at a basic level. On top of that, and I think most of us would agree,

the community as represented by the politicians has the right to urge the solution of problems facing the community, and it may be then when you put these to us and to other fields of science that we will say "the best thing for this is an institute, either a physical institute, a building and so forth or an institute in the sense that you have 3 or 4 groups in different places who have common funding and are inter-related and are working together on the problem". I think this is a situation where there has to be dialogue and when you present these challenges to the scientists they can get their teeth into them from the point of view of giving precise advice.

Senator Cameron: You do not see in the proliferation of institutes the establishment of a series of competing agencies?

Dr. Stevenson: One would hope not, and one would hope that with the continuation of this committee and so forth government will be able to see from the information available when competition is becoming unhealthy and unworkable.

Dr. Whitaker: Mr. Chairman, with regard to one recommendation in that brief, I think we as biochemists would have some reservations about it; that is the suggestion of forming—I forget the phrase—a separate biological research council. I think we would have reservations about it for this reason, that this type of change could lead to a compartmentalization of science and I think it is often true that some of the most interesting aspects of research now are the interfaces between different departments, in our case the interface between chemistry, physics and biology. I think we as biochemists would have some reservations about that particular recommendation.

Dr. Stevenson: I think this is why it was put forward as a recommendation—that it should be under the NRC because that means that if the experiment did not work or proved impossible, it would not be an agency that could not be absorbed back into the parent body. It would not be a separate entity on its own.

The Chairman: I understood that your suggestion was that this new organization would have more or less the same status as the Medical Research Council before it was detached from NRC.

Senator Grosart: Mr. Chairman, may I say this, that in spite of the reservation made on

page 15 and following seeming to suggest that you are not recommending a ministry of science policy, I think in effect you are because it recommends...

The Chairman: I think Dr. Stevenson said he was favouring this as opposed to a minister who would be in charge of all research labs and all this. That is what I understood.

Senator Grosart: As I understand what the brief says—and that is what we are considering—it suggests that the minister will be the chairman of the Cabinet council who will have a staff. He is either a minister without portfolio, which means that he is useless—I do not mean all ministers without portfolio are, but a minister in that capacity, described as a minister without portfolio, is useless in terms of this mechanism. If he is not a minister without portfolio, he must be a minister with portfolio, and there is no other way of describing him, unless we devise something new. What is his portfolio?

The Chairman: There are all kinds of possibilities.

Senator Grosart: I will not suggest them at the moment, as I do not want to get into current politics. He is going to wind up being a Minister on Science Policy.

Dr. Stevenson: We are not as experienced at this level of government as you are. We are trying to get across that it should be somebody at Cabinet level who does not have other responsibilities and does not discuss science after he has finished with Mines or Treasury Board, or something else; but, if you want, a political philosopher on science at Cabinet level. We do not want him to have under him a huge bureaucracy which then pervades the whole of scientific effort and takes away communication with government, and so forth.

The Chairman: I do not know if you have seen the Tyas study on scientific and technological information.

Dr. Stevenson: No.

The Chairman: It has been published now. They are proposing that we should have a kind of national centre to support the individual efforts and to get a more efficient system of information on science and technology in Canada. They have been suggesting that this centre, if it is to be formed by the

Government, should be responsible to that minister.

Dr. Stevenson: There might be some central agency which could go under that minister. We do not want to see it developed to such an extent that you do not ask our representatives to come back here every year or two years to talk to you, but we are told to talk to the fifth deputy minister, and that is the end of our communication with our government. This is what we want to avoid.

Senator Grosart: The inventory problem, that Senator Cameron has drawn attention to so often, seems to be a logical responsibility for such a minister. You say on page 10:

A more factual statistical classification will be required to ensure the effective implementation of any priorities associated with science policy.

And I agree. Yet the evidence we have had here, over and over again, is that there is no inventory. I must put on record that in your "Directory of Biochemical Training and Research in Canada" you have made an excellent start at filling the gap. Is there anything comparable in the other disciplines?

Dr. Stevenson: I cannot speak for all of them. I think perhaps they are being developed in some.

Dr. Gorham: There has been in some societies something comparable to this. I think the Canadian Society of Phytopathologists has one.

Dr. Hinton: We recognize this inventory problem and we cannot give you the basic data to work with. The biochemists did a good job with it, but I am in there and so are a whole lot of other people I would not normally designate as a biochemist. So, it is a fatuous problem saying who is a biologist, who is a biochemist, and so on. We have not a device for accumulating our inventory because as we try to do it as individual societies we run right on the rocks of confusion about what name is what.

Senator Grosart: It is not an unusual problem. It is a problem that library science has been dealing with ever since it started. It is never going to solve it but that does not prevent librarians trying.

Senator Carter: This is a record of what is being done, but I think Dr. Hinton said there are many brilliant ideas that never got acted

on at all, because there is no base line money there to start with. Ideas are a very valuable natural resource. Is there any ideas bank or any way of saving these ideas and evaluating them? Is this something the central agency should be doing?

Dr. Stevenson: I think it is difficult for a central agency. I think there is an ideas bank, in the sense it is where the scientific meetings are so important and what is said at them goes into many people's memories.

Senator Carter: Are they recorded in any way?

Dr. Stevenson: They may not be actually recorded, but they may be recorded in the discussion section of a science paper. However, with science changing very rapidly, today's idea may be part of an idea six months from now, but it is changed by what has happened since. However, there is this discussion in the scientific papers and the literature, and Canada is developing good scientific journals of its own. It is there that we keep our ideas bank.

Senator Carter: These have been selected from a large pool, and somebody has to make a choice between this one which is included and another that is discarded. What kind of mechanism is there for doing that? Do you evaluate it with a panel?

Dr. Whitaker: This was done very easily, and I can say that because I organized it. The reason you are listed, Dr. Hinton, is because the person at Queen's asked to organize the non-biochemistry department decided you were almost a biochemist, and this was done in every university and it was a case of individual people making their choice. We decided this was the only practical way to do it.

The Chairman: Do you consider this a compliment or an insult?

Dr. Hinton: I would consider it a natural phenomenon!

Dr. Stevenson: With regard to the question of choice of ideas, there are panels. The individual scientist having an idea makes out an application and will organize his work in connection with NRC or some other agency, and he shows the budget he thinks necessary to approach this problem. This goes to the agency and there it is judged by a panel of his peers—in other words, other professional

scientists—who read the various ideas related to their bodies in order of priority, and they are funded, in order of priority, until all the money that Parliament has voted them for that year is used up.

Senator Carter: If he is a poor man at expressing ideas maybe he will lose out, although his idea may be a lot better than some others.

Dr. Stevenson: It is expected that the ability to express one's ideas is part of the competence of a professional scientist.

Senator Cameron: Hear, hear.

Dr. Stevenson: He may get help from many of his colleagues. If he is a young man, then his senior colleagues in the university or at the government institute will give him a great deal of help in polishing, and if he wants it to be polished, he has no problems and will always have help. Competition in science does not go as far as excluding that sort of help.

May I say that your offer of yesterday of a love affair between the politicians and science would be well accepted. In fact, on behalf of science, we would happily offer science in marriage, if you give science a good dowry, keep her pregnant, productive and well fed!

The Chairman: I would be tempted to end this meeting on that note, but I am sure there are still other questions to be asked.

Senator Grosart: On page 12 there is a statement, referring to federal support of scientific research at universities:

It should not provide equal funds for distribution by the provinces.

What is the problem there? Does it arise out of a problem created in the past by distribution by the provinces?

Dr. Stevenson: It arises out of suggestions that are in the air that provincial groups should have more say in the allocation of funds. I would say that for most of the scientific disciplines in Canada the feeling is that the community of scientists is too small for there to be sufficient scientists in any province to provide these peer panels that were talked about. It becomes a matter in any one province of the five or six people there splitting up the funds. We find that the national effort for Canada is by far the best. It is just; it has been, within its limits, extremely profitable; it has been stimulating for scien-

tists from all over the country to have been brought together for decisions of this nature.

Senator Grosart: Yesterday we had a completely contrary suggestion made in the brief from the Alberta Human Resources Council, asking for federal funding in a situation where it sees a need for funds. It disburses two-thirds of its funds in commissions or grants-in-aid. This is the very opposite of your suggestion. This illustrates some of the problems and choices that we have to make between viewpoints put forward. We also had within the last two days a very strong plea on behalf of the provincial research institutes for the same thing. This is why I raise the question.

To what extent should the funding be centralized? The scientists tell us much about waste in public funding of R & D. Often they suggest, as a cure, decision-making at a high level of the national science community by national peers at peers level. At other times they seem to say, put the money where the work is being done and let the decision be made there.

What, then, is the viable philosophy of distinguishing between centralization and decentralization or fragmentation as some call it in the area of science funding?

Dr. Stevenson: You are asking a political as well as a scientific question.

Senator Grosart: I am always doing that.

Dr. Stevenson: This is perfectly fair, sir, so I will answer both as scientist and politician.

The Chairman: Senator Grosart rarely asks questions that are scientific.

Senator Grosart: And doesn't always get scientific answers.

Dr. Stevenson: We Canadian scientists have the same heritage as you Canadian politicians, so there are these problems for us. I would ask any member of the scientific group in the room to disagree with me if they would. We think that for the kind of science we are talking about here, particularly the fundamental science, and for national problems of applied science, it is best to have this done by the federal Government. This is even better for the people living in the provinces, where most Canadians do live, I admit. This brings the whole scientific community to bear on the problem in terms of the peer criticism,

where the emphasis should go, and so forth. The provinces, I think, would find their own money for something that their government had a specific applied interest in. This would be their duty, but I think the vast majority of scientists are in favour of a national science policy and national science funding. On the other hand, I must say in terms of the country as a whole scientists would be in favour of a certain amount of respect for regions. We do not want to see all scientists and all science piled up in one part of the country, because this is bad for education, industry and the community. To have the scientists reasonably spread out in the two languages is a good thing. I think it must be remembered that scientists do a great deal of what is commonly called public service, giving advice in all sorts of local matters that do not appear in their research publications. Therefore it is worthwhile having them reasonably distributed across our country.

Dr. Cook: I thought I could answer Senator Grosart's question on this statement:

It should not provide equal funds for distribution by the provinces.

This may not have been very good writing, of which you were complimentary earlier. What the group had in mind was that they do not like research financed by a 50-50 arrangement; it stands for the support of education in the university. The rest of it fits into what has already been said here.

The Chairman: We have been discussing this morning the relationships between your societies and your own scientific interest only in relation to NRC and MRC. I would like now to raise a rather new question about this and ask you whether you feel that there is too much research going on at the present time in your various fields in mission-oriented agencies within the federal Government? Let us say in the Department of Health and Welfare, the Department of Agriculture, the Department of Fisheries or the Department of Forestry. We have been told, for instance, that the Department of Agriculture does not provide much funds for extramural research, or that the Department of Forestry has concentrated on its own labs. Do you have any views on this in relation to biology?

Dr. Fisher: This also is a tremendously important question, Mr. Senator. It is one that I think a lot of attention needs to be paid to. It is very difficult to give a pat answer to

it. Again I am not sure that my view would be a view that would be shared by everybody.

I would like to take the view that the C.D.A. for example, has been given a responsibility by us as Canadians to think at the federal level of matters in agriculture and that we should encourage them to think about this in the broadest possible sense. I do not see how it is sensible any longer to try to pretend that you can think about one little bit of agriculture and not about the rest of it.

If you have to have agricultural scientists to carry out federal and departmental policies, how can you do this without simultaneously thinking about the production of the people who are going to do this?

In our report there will be several blatant examples of this. I think this is a bad situation; this requires a rather different kind of view and a broader one which gives them more responsibility in a sense for at least planning and thinking than has existed in the past. It seems to me that this is logical. However, it is a mission-oriented group. Again I would like to say that this must be kept to the fore continuously and that they should give contracts. It is not that the contract might not be given to a university or to an industry; I would not want to draw any line as to where they give it.

The Chairman: It depends on the project.

Dr. Fisher: They must look for the suitable agency, but suppose that they feel that there is not enough of a certain kind of person being produced, there is no reason why a contract should not be given; it would be of the sort that are called teaching contracts, teaching grants in the United States, for the specific purpose of bringing along a body of people in a given line of work. I see no reason why this could not be done or should not be done as a way around this. I think a question was also asked about the amount of basic research they do intramurally, in their own establishments.

The Chairman: Yes, their general programs. It may seem that certain of these mission-oriented agencies are perhaps trying to do too much themselves and live in isolation from the universities and industry.

Dr. Fisher: Again it is dangerous without going into a great amount of detail. One thing that can be stated immediately is that at any

rate some departments have been prevented by the acts governing them from doing some of the things they see themselves they ought to be doing. I have talked to enough people to see this. There is basic research going on. As part of our survey we looked at this with the C.D.A. at some length and spent several days discussion on it. There is great difficulty in deciding how much basic research there should be. This was done in the States in big industry and an average figure of something like 10 per cent or 12 per cent came out as the amount of research of a basic nature carried out. It varied from zero to around 22 per cent. C.D.A. is doing a little more than this. I think probably in the long run they will reduce it because the atmosphere is changing, and I think perhaps a better arrangement from their standpoint will arise.

I am not too happy about the comments that are commonly made suggesting that too much basic research is being done in fisheries or some other place. I do not believe this is the right distinction to make. The right distinction is rather the one made by Dr. D'Iorio down in the U.S. Senate in the past year, which is that the research done should be done in the place where it is most appropriate. There are certain kinds of very basic research that I do not think fit the universities at all. I feel very strongly that this is the place where, if research is worth while doing, it should be picked up. If federal or provincial governments say it should be some place else, I see no reason why contracts—and some are being given now—should not be given to industry to do specific jobs. I feel that we should not do any work which some organization in the private sector can do—and this again is the view Dr. D'Iorio has taken—and possibly can do better; one does not know.

Senator Cameron: This would apply to provincial research councils as well as universities, would it not?

Dr. Fisher: I think provincial research councils should be strengthened. I do not know that it is the federal responsibility to strengthen them, but I feel very strongly that every province should have one and that it should be pervasive in the government, it should be brought to bear upon every aspect of government where it can have an effect. An operational research point of view should be taken, among other things.

Senator Carter: It must be very difficult to draw the line between basic research and

mission-oriented research in the biological and biochemical field?

Dr. Fisher: Yes, it is impossible. Part of our survey defined an area of biology which I knew had an application, but my goodness gracious me, on the whole story presented to me by a panel I have trouble in finding basic research in it; as far as I can see it is all application. It is very difficult to draw the line in the universities as well as the government.

Senator Cameron: You refer to some acts that circumscribe the freedom of government departments. It might be useful to this committee to have a list of those acts so that we can examine them too. Perhaps that could be done at some time at your convenience.

Dr. Fisher: I would prefer that this was not part of the record, because I have not myself searched these things. I have this second-hand and I could be wrong. For example, several times the point has been made that it is impossible to think of science today or any branch of our civilization out of contact with economics and sociology. This is not to say all research has to be economic immediately.

The Chairman: That would be too nice.

Dr. Fisher: Yes, it would be too nice. Therefore, any organization such as the Canadian Department of Agriculture, for example, is working in a vacuum if it does research without an economic background. The CDA has a very good economic background, but I imagine the same thing may apply to fisheries, who I do not believe have any economics.

The Chairman: I think they have some. Is that right, Senator Robichaud?

Senator Robichaud: Yes.

Dr. Fisher: They have some economics?

The Chairman: Yes. I do not think they have in forestry.

Dr. Fisher: I had been led to believe that there was not any economics in fisheries, that the act specifically forbids it. This is why I do not want to be quoted, because I have not personally checked this.

The Chairman: That will have been noted for the record.

Dr. Fisher: This is all I meant. We should have the total picture brought forward to be realistic, if we are going to play for keeps.

Dr. Munro: I would like to comment briefly on this subject. I think it fair to say it is one on which there is not complete unanimity in the scientific community, partly on grounds on principle and partly because of divergent institutional interests. Those who have had to look at the wider problems or change their orientation from time to time tend to take broader views later than they did earlier. I think both Dr. Fisher and I have gone through this process. Although he comes from a university background, he has made some very constructive and generous remarks about the government service. Most of my working life has been spent in government service, but I see certain defects in the way we have had to arrange things.

The Chairman: This is the great advantage of the mobility of our scientific community.

Dr. Munro: Yes, it is, sir, and I think that is one of the points I would like to make. I believe that one of our diseases has been on the one hand institutional loyalty, loyalty to national and mission objectives, and on the other hand what I may describe as loyalty—to use your phrase—to the republic of science, to the advancement of human knowledge, which I continue to consider as one of the fundamental motivations of science.

Be that as it may, certainly we have done a great deal in government departments of Canada, more than most other developed countries. I question whether it has been well established on objective grounds that this is either a good thing or a bad thing. We have done different things from some other countries, and it has brought us some advantages. We have concentrated on things at a time when our resources were relatively small. For instance, in agricultural research we have occupied a position far out of proportion to the level of national resources, partly because agriculture has historically been very important and partly because we have had, in general, good arrangements for agricultural research. We have also, in this and other departments, taken responsibility for carrying a great deal of basic research. Grantsmanship being what it is, a good deal of basic research and scientific research has, in the past, been carried out because of its potential relation to agricultural science or mission-oriented sciences rather than because of the certain

relationship that you can demonstrate tomorrow, still less because of a sober economic analysis, if such is yet possible. This may have been a good thing up to a point, but now when we are trying to determine in a more rationally defined and controllable way what our objectives are and how we are meeting them, trying to define these things, we are suffering the penalty of our trifling with a fully objective description in the past. People can readily say you are doing agriculture so why all this basic biological research, whereas, in effect, I think it is not wrong to say that we have been carrying a large part of the responsibility of a National Research Council type of laboratory in this area. Maybe this is right and maybe it is wrong, but my judgment at this point is that the social pressures are such that much of this basic research will, in future, be done in the now much stronger and more capable universities. There are structural pressures in government which seem to me to tend the same way.

The Government is getting bigger and more complex, therefore, its procedures are getting more formalized. I do not need to go into detail, but the whole question of personnel and administration is being revolutionized and getting much more towards a formal management, adapted to the large mass of Government regulatory and service organizations. There are difficulties in operating a scientific establishment in a really desirable way within this framework, and the bigger they are the more difficulties there are. I think this will tend to press some of our scientific work into the outside community, and therefore I think we are going to be faced with changes. If these changes are handled well it will be beneficial, but the period of transition is going to be a critical one. We are looking at things where there are large on-going, good programs, and, if the support picture changes, the centre of gravity is going to change. If it changes too fast or by inap-

propriate means, very good programs are going to be dislocated and very good people are going to be thrown into a state of having a difficult time to fit into the new structures or even becoming disaffected and discouraged. Over the next period of a few years I think this will be an operational problem of sufficient dimensions that ought to be of active concern to those responsible to the science policy.

Dr. Eagles: Mr. Chairman, it is with considerable diffidence that I speak at this moment. As you know, I am one of those on the shelf, retired. As a former Dean of Agriculture, who has had a great deal of comings and goings with the federal Department of Agriculture and with the National Research Council, I can say that many of these things have been discussed over the years.

I came here this morning to speak as the President of the Canadian Society of Microbiologists. I hesitate to get out of that role, but it did strike me as a general comment, and to say again how much I welcome, personally, the Senate Science Policy Committee. In the terms of a microbiologist and his job, being that of a microbiological one, we must face the problem that the most constant characteristic of a micro-organism is its ability to change and how to determine that. All these bodies through other years have contributed greatly to that. I think the most significant thing that has happened is this body of which you are chairman, sir.

The Chairman: Thank you very much. Now that I have received my personal compliment from this meeting, I do certainly want, as a committee, to thank you very much for this most interesting morning. As you have expressed this so often this morning, this is the first time we have been able to meet together, but I can promise you on behalf of my colleagues this will not be the last time.

The committee adjourned.

APPENDIX 101

SENATE COMMITTEE ON SCIENCE POLICY

SUBMISSION BY

THE BIOLOGICAL COUNCIL OF CANADA

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ABSTRACT OF THE BRIEF TO THE SPECIAL SENATE COMMITTEE
ON SCIENCE POLICY FROM BIOLOGICAL COUNCIL OF CANADA

In this brief life science is used as an all-inclusive term embracing the basic biologies at all levels (communities, populations, individuals, cellular and molecular) and also their applications in agriculture, fisheries, forestry, health and medical science. In spite of its scope and its social and economic importance, life science receives a much smaller proportion of the nation's research dollar than does physical science. Universities and government laboratories carry the major financial responsibility since industrial contributions to biological science are comparatively small. In Canada life science receives only one-third of federal research funds while comparable federal agencies in the U.S. assign over half their funds to this field. Canadian life science can record some notable achievements but additional resources are required if it is to deal adequately with current and future problems. Intensification of effort is recommended in three broad areas: basic biology at all levels, medical and health science, and problems of environmental deterioration. The BCC recommends that the Privy Council Committee for Scientific and Industrial Research become the political entity for formulating science policy and that its chairman be a minister without other departmental responsibilities. It is suggested that an agency responsible for funding biological research be formed under NRC to avoid a proliferation of agencies. Finally, a plea is made to include human resource development as an integral part of the planning for a comprehensive science policy. A more detailed appraisal of current needs in entomology is attached (Appendix B).

I. PREFACE

In Canada physical scientists are organized into relatively few professional societies (i.e., Chemical Institute of Canada, Canadian Association of Physics, Engineering Institute of Canada) that speak for their respective professions at the policy level. In contrast biological science is fragmented into a number of specialist societies and although six of these, known as the Canadian Federation of Biological Societies (CFBS), organize and hold common scientific meetings they do not represent the complete spectrum of biological disciplines. In an attempt to provide a body that could speak for biologists at a policy level, the Biological Council of Canada (BCC) was formed later in 1966, following organizational meetings held over the two previous years. At present this Council is made up of two representatives from each of fourteen national biological societies, listed in Appendix A¹. Meetings are held twice annually and several of its committees meet more frequently.

Recognizing that there are contributions to the economic and social life of Canadians that can be made only by biological science, the purpose of the BCC is to promote its growth. To this end the Council wants to assure that recruitment, training and research in the biological sciences are adequate to meet present and future needs and that they receive appropriate recognition in the policies and priorities of government, research agencies, institutions of higher learning, and industry.

The BCC has entered into contractual obligations with the Science Secretariat (now Science Council Office) in conducting a survey of basic biological research in Canada. This report is not yet available.

¹ One or more of these societies may present its own brief to the Special Committee of the Senate, and others are attached to this brief as Appendices.

II. INTRODUCTION

Some of the most urgent national and international problems are primarily biological in nature or have a major biological component. Thus, an ever-increasing world population has given rise to serious problems in food production, deterioration of the environment (e.g., pollution), and the need to maintain and improve current standards of health.

Man cannot live in ignorance of his biological dependence. Medical science has developed through his desire for good health. The need for food and shelter has demanded a knowledge of agriculture, fisheries and forestry. Preservation of the environment in an era of increasing industrialization and urbanization is largely biological and of major social significance. Basic biological science provides the fundamental knowledge for solving problems of economic and social significance and is stimulated by man's curiosity about life and living processes.

III. THE SCOPE OF BIOLOGY

The term "life science" has been used to describe all disciplines that have a major biological component, including agriculture, fisheries and forestry, health and medical science, in addition to the basic biological disciplines on which all successful applications depend. This definition of life science places it between what has been termed social science and physical science. Recognizing the fundamental unity of all science, the borderlines cannot be defined sharply nor is this desirable in an era

when many of our urgent problems are in need of a multidisciplinary approach. Indeed, modern biology is a whole spectrum of disciplines with one common element - a knowledge of living things.

The enormity of biological science can be realized when it is recalled that several million species of animals and plants have been distinguished, described and classified, and several million more may exist in nature. The complexity is indicated by the diversity of forms, each of which reproduces its own kind and these may be modified by the physical and biological environment.

The behaviour of living things is characterized by a continual adjustment to forces within and outside themselves. Extinction may follow sudden or drastic internal or environmental changes that exceed the elasticity of the organism's control mechanisms. These control mechanisms for the preservation of type and function of species have been studied at several levels, outlined below, and, taken together, have provided our basic knowledge of all life science.

Communities

Living organisms are so interdependent on one another that no single species can survive alone but must live in a community of populations if they are to survive. The physical features of the ecosystem, such as light, temperature, water etc. must therefore support a community of populations that interact with one another and attain a balance. The elasticity of these ecosystems is not unlimited and rapid advances in technology threaten the environmental balance. Pesticides

used to increase food production may be present in only micro amounts but they can be concentrated in the body substance of certain species and thereby threaten the food supply of others.² A good example of this is the threat of extinction of the peregrine falcon because of the build up in these creatures of toxic amounts of D.D.T. Human food will be protected through contaminant detection and regulations but fish and wildlife cannot be so protected.

Populations

Within the community the genetic make-up of a species will determine its fitness to survive and become a population. Recombination of the hereditary factors has, through natural evolution, produced species capable of surviving environmental changes where these have occurred. Knowledge of this genetic mechanism has enabled man to accelerate these changes and produce superior strains of domestic animals and plants, e.g., rust-resistant wheat. Recent work has produced high-yielding rice and wheat varieties that have kept a substantial proportion of the world's population above the starvation line. Control of our own genetic make-up appears to be possible within the foreseeable future, perhaps by the end of the 20th century.

Individual organisms

Within a species there are great variations among individuals, whether it be a population of higher animals or microorganisms. Selection of superior individuals has provided a basis for improvement where the

² Science New - February 22, 1969

organism was of interest to man. In a common environment this difference is genetic and represents the portion of the gene pool of the species inherited by the individual. Two things are required for continued improvements of this type: (i) extending our knowledge of the basic processes involved, and (ii) maintenance of any adequate gene pool for future work.

Cellular biology and organ systems

All living organisms from unicellular bacteria to the highest forms are composed of cells. Single-celled bacteria cause many of our plant and animal diseases but others are responsible for antibiotic synthesis and industrial fermentations. In the higher organisms all cells originate from a single fertilized cell but differentiation and grouping produce the specialized organ systems that perform control functions such as the nervous system and glands that secrete hormones. As yet we know comparatively little about the basic nature of cell differentiation that produces the specialized organs. Immunization represents the cell's defence mechanism against disease but the same process is also responsible for the frequent rejection of organ transplants.

Subcellular - biochemistry and molecular biology

Investigations at the subcellular level have shown that deoxyribonucleic acid (DNA) in the cell nucleus carries the genetic code that determines the hereditary mechanism and the synthesis of highly specific enzymes that control the cell's metabolism and growth. The genetic code appears to be a unifying principle in that the widely different specifications for different forms of plant and animal life are all written in the same molecular language.

This brief outline serves to highlight the need for investigation of biology at many levels. It also indicates the diversity of training required, and the spectrum of disciplines that has emerged. Useful applications have come out of these studies and additional practical advantages could be gained by expanding our resources in biological science. Such extensions must, however, be accompanied by an expansion of basic biological research at all levels. Lacking this essential, we shall have neither the knowledge nor the skills to make new applications at the necessary rate.

IV. CANADIAN LIFE SCIENCE

Canadian life science is characterized by competence in certain broad areas, excellence in a few, and marked weaknesses in others. Competence has been developed primarily in areas where a serious need had arisen, because it could then command strong support. Thus, wheat rust caused great economic loss and in building up a research capability to solve this problem, a broad competence was developed in related areas of agriculture. To attain excellence in a scientific field, as distinct from excellence in an individual, the basic problems must be anticipated, the approach planned, and the resources provided in advance in order to attain the leadership the nation has the right to expect.

A brief over-view of Canadian resources shows that we are weak at the level of biological communities in spite of worthy efforts of a few individuals in certain areas. This level includes the broad problem of environmental deterioration which has been taking place for years and is now receiving consideration at the United Nations³, but only recently

³United Nations General Assembly - Item 91. 23 Session.
"The problems of human environment" A/7291. Nov. 1968.

have we begun to consider studies in the area of water pollution. We need to develop a broad multidisciplinary competence involving many of the biological disciplines, engineering, and social science. This is not the kind of problem that will be solved by studies in other countries since the Canadian environment is unique to Canada.

A broad competence has been developed for improving the quality of populations and individual organisms of agricultural interest. Excellent work has also been done in the related fields of insect pests, forestry and fisheries. In several of these fields this competence has been developed with limited resources after the problem had arisen. Success can be attributed to excellence in the individual and the relatively short-term planning. Some of these solutions are of an interim nature and an expanded effort will be required to keep pace with the rapid rate of change and the anticipation of future control measures.

The knowledge required for anticipating future requirements in all fields will come from basic studies and those at the cellular and molecular levels will affect the whole field of life science. While work in these areas has received increased support in recent years, they are still weak areas when viewed in the international context.

V. RESOURCES FOR LIFE SCIENCE RESEARCH

Detailed statistics on Canadian research expenditures for life science are inadequate and will not be available until current surveys are completed. Research expenditures or personnel figures are usually

given under such headings as medicine, agriculture, forestry, fisheries etc. and basic biological science is seldom shown separately. Expenditures on basic physical science (e.g., physics and chemistry), however, are commonly separated from those of the several branches of engineering. At present the only reasonably reliable over-all figure is the proportion of the nation's R and D dollar that is spent on life science. In spite of differential increases in R and D funds from year to year, this ratio remains reasonably constant since research expenditures for all purposes tend to show parallel increases. It appears that life science receives about a quarter of the nation's research dollar. Governments assign a higher proportion of their funds to life science but this is reduced by the proportionally smaller expenditures of industry in this area.

Expenditures by federal departments and agencies with major responsibilities in life science are given for 1968-69 in Table I. In the multidisciplinary resource departments expenditures on non-biological subjects (e.g., engineering and economics) and non-research topics (regulatory and service functions) may represent a fifth or more of the reported figures. The figures therefore overestimate life science R and D expenditures by the listed departments but this is at least partly compensated by biological research conducted as a minor component in other federal organs not included in the table.

Table I shows that 126 million dollars or about a third⁴ of estimated federal expenditures on research in 1968-69 was spent on life science. University expenditures on research are difficult to estimate

⁴Background Studies in Science Policy. Special Study No. 6. Science Council of Canada 1969.

because of indirect costs (discussed later) but it appears that they spend between 35 and 40% of their research budget on life science. Since these proportions are higher than the proportion of the national research dollar allotted to life science, it is clear that the public sector carries the major responsibility in this area. This is to be expected - governments will always have to carry the largest share of research expenditures in areas of social interest (e.g., health) and in those where the economic units (e.g., agriculture) are too small to do their own research.

In the United States about a quarter of the total federal research expenditure is for life science and appears therefore to be less than the proportion (one-third) spent in Canada. The U.S. figures, however, include expenditures made by the Department of Defense (DOD), National Air and Space Administration (NASA) and Atomic Energy Corporation (AEC) that spend comparatively little on life science research and have no counterpart in Canada. Basing comparison only on the 2.4 billion research budget of the other 29 agencies, they spend some 56% of their research funds for life science. In this area the largest contributor is the Department of Health, Education and Welfare which assigns 81% of its funds for life science research while the other 28 agencies assign ^{5.} 36%

A further breakdown of life science research expenditure by all U.S. federal agencies indicates that about 63% is spent on medical science, 29% on biological science, and 8% on agricultural science. Comparable figures are not available for Canada where basic biological

⁵National Science Foundation, Federal Funds for Research, Development and other Scientific Activities (1967) Vol. XVI, p.30.

research in government departments is seldom distinguished (in the statistics produced) from their applied or mission oriented research whether it be agriculture, fisheries or medicine. Similarly, in Canadian universities with agricultural and medical faculties, basic biological research is classified as agricultural and medical research. A more factual statistical classification will be required to ensure the effective implementation of any priorities associated with science policy.

The figures in Table I show that two-thirds of the federal government's expenditures on life science are "in-house" and one-third extramural, largely as research grants to universities. However, it would be erroneous to conclude that government laboratories spend twice as much as university laboratories on life science. In-house expenditures represent total costs, including such indirect costs as space, services, maintenance and overhead, that are not present in university grants. These indirect costs essentially equal the direct costs and universities provide these from their own resources. In addition the universities provide staff salaries and funds obtained from other sources such as the voluntary health agencies. Consequently, the resources available for life science research in university laboratories equal or exceed those available in government laboratories.

VI. POLICY

There has been a tendency to discuss science policy either entirely in relation to economic and social goals, or as an end in itself unrelated to national objectives. This reflects the two kinds of decisions required

in formulating policy, namely, the role of science in advancing broader goals, and the support of pure science solely as a contribution to knowledge. While these two scientific objectives are interdependent, their relative magnitude will be determined by somewhat different considerations.

For advancing economic and social objectives, the first step is to define national goals and this is a political decision that must be based on much broader considerations than science alone. Such goals must be assessed in terms of public benefit, the probability of success at all levels (scientific, economic, industrial, social etc.) and the resources available for their accomplishment. A scientific solution is not enough, as failure at any other level would mean that the scientific effort would be largely wasted. The scope and kind of scientific effort required will depend on the objective and this is largely a scientific decision. Again, the available resources may have to be focussed on a limited number of objectives. This will require priorities based on both political and scientific decisions. When these decisions are taken, research and development costs can be estimated without assuming that they be some arbitrary percentage of the G.N.P.

Pure science must be supported to provide trained personnel and the foundation on which all applications are based. Indeed, in life science lack of basic knowledge is often the factor limiting successful applications. Contribution to knowledge is the ultimate goal of basic research and should be done primarily, but not exclusively, in our universities. Mission-oriented groups outside our universities may also

have to undertake some basic work to attain their objective. Here the ultimate decisions will be based on the extent and kind of pure research that will permit the nation to accomplish its educational and other objectives related to its national goals. The relative importance and cost of acquiring new knowledge in physical and life science must be considered. Facilities for physical science are generally more expensive; shore station and ships for studies of biological oceanography are generally less costly than modern particle accelerators and space research.

Basic knowledge of living things, including man himself, would appear to be of the highest importance, and yet it gets a relatively small proportion of the nation's research dollar. Biological studies may yield results of both economic and social importance, including the improvement in some present-day consequences of industrial development.

While the BCC realizes that education is a provincial matter, it contends that scientific research is a federal matter and the federal government should maintain independent financial support of scientific research at universities. It should not provide equal funds for distribution by the provinces. Granting agencies such as NRC and MRC should have a broad mandate to support basic research and applied work that falls outside departmental interests.

The BCC considers that the following general areas represent the highest priorities for Canadian life science, and recommends accordingly:

1. Increased support of basic biological science. The studies

envisioned extend over all levels from subcellular studies to ecological investigations of communities, and support for such work in the science departments of our universities is strongly urged.

Studies on specific areas of life science should be confined to a limited number of universities or institutions in order to build up adequate strength in each area to permit effective work (Appendix B). This will conserve resources by creating strong centres of training and research in different areas in different institutions. These centres should preferably be established in science faculties to facilitate the creation of multi-disciplinary teams made up of biologists and other disciplines.

2. Support of the health sciences is of interest to all Canadians and improved health services will demand strengthening medical research. Nation-wide medicare will require the services of more medical and paramedical personnel and in future a higher proportion of them will have to be trained at home. The growing sophistication of diagnostic, medical, and surgical treatment procedures means that adequate training can be provided only in association with strong health research centres. Research objectives that rate high in priority include cardiovascular and viral diseases, cancer, accidents and the rejection mechanism that limits the use of organ transplants.
3. The Third goal is the maintenance of the environment - a problem that demands attention not only from the majority of biological

Brief from Entomological Society of Canada

disciplines but also from physical and social scientists. The Canadian climate, geography and biosphere are unique, research done elsewhere may be helpful, but these problems will not be solved by the work of others. Environmental pollution is only one manifestation of this general problem. Explorations for mineral resources threaten the tundra of our Arctic, and increased industrialization and urbanization continue to accelerate environmental deterioration in the more populated areas. In terms of community benefit, biological research on the environment is as important as medical and economic studies.

Universities and government are most likely to pursue activities that benefit the public; industrial research is less likely to consider social benefit if there is any conflict with the profit motive. Industrial pollution is of biological interest and for some industries economic control of pollution will require changes in procedures and processes, and such developments can best be studied by the companies concerned. Increased industrial participation in biological research would be desirable and the government has already established several incentive schemes to⁶ encourage industrial research⁷. The Science Council has also recommended that the Federal government "further encourage industrial involvement by contracting our federal programs -----to increase technological and innovative capabilities-----". Extension of this recommendation to cover such social problems as environmental pollution would appear to be well justified.

⁶Income tax reductions, PAIT (Department of Industry); IRAP (NRC).

⁷Science Council Report No.4.

As has been said, national goals must be decided at the political level but scientific advice will be required to estimate feasibility and costs and to set priorities. The BCC therefore wishes to record the following observations and recommendations concerning the implementation of policy. The Privy Council Committee for Scientific and Industrial Research has as its members the ministers whose departments have major responsibilities for scientific research. Since this committee is established in the Research Council Act, its primary responsibility appears to be for N.R.C. and related agencies rather than for science policy within departments. The Science Secretariat attached to the Privy Council Office may have broader responsibilities in establishing and implementing policy but as yet the extent of their responsibilities is not well known in the scientific community. The Science Council is an advisory body consisting mainly of scientists who can advise on scientific matters but cannot make the ultimate decisions on national goals at the political level. Finally, the Treasury Board, while it does not establish scientific goals, exerts an important control over scientific effort by determining the funds available.

At the operational level scientific research is a major activity in the resource departments. These departments have a purpose and mission and in this technological age science forms an important part of that mission. To remove responsibility for scientific activity from these departments and consolidate it under a ministry of science would appear to be a retrograde step since it would increase the gap between well-defined problems and the scientific capability needed for their solution.

For this reason the establishment of a ministry of science would not appear to be the best method of reducing the present fragmentation.

Several departments may be served by advisory boards (e.g., DRB and FRB) that bring a broad consensus of scientific and industrial opinion to the departments they serve. These boards should be retained as they perform an important function at the scientific level. All departments authorized to make major expenditures on extramural research should have advisory boards containing outside experts to provide a broad basis for⁸ all decisions. This is consistent with the views of the Science Council .

The formation of national goals, the priorities and funds available, must be decided at the highest political level. The Privy Council Committee for Scientific and Industrial Research, made up of ministers from departments with major scientific activities, and to whom the National Research Council and several specialized agencies report, would appear to provide a potential link with all federal scientific activity. The appointment of a chairman for this committee at the ministerial level, but without other departmental responsibilities, as in the past, would appear to provide a satisfactory body for formulating national goals and science policy. The present arrangement of having one minister serve as both Chairman of the Privy Council Committee for Scientific and Industrial Research, and Chairman of the Treasury Board appears to be completely anomalous. Under the proposed reorganization the present Science Secretariat could function as part of the chairman's staff and the Science Council as an over-all advisory body.

⁸ Science Council Report No. 4, p.32

To strengthen biological science in Canada, the ECC proposes that a Biological Research Board, or Council, be established by statute under the NRC Act. This agency would function much as did MRC prior to its transfer to the Department of National Health and Welfare, and thus avoid the creation of more agencies. At present only one-sixth of NRC's "in-house" appropriation is for biological research, about a quarter of the funds spent on university grants are in biological fields, and of the twenty-one members of this Council only two are biologists and one a medical doctor. Formation of a Biological Research Board, made up of life scientists from university, government and industry, with its own budgetary vote, and operating under the NRC Act, could do much to give biological research its rightful place in the Canadian scientific effort.

The Biological Council of Canada compliments the Special Committee of the Senate on Science Policy on the excellence of its work, the broad spectrum of scientists and organizations it has consulted, and the objective approach it has brought to the assessment of a complex subject. When the Special Committee has produced its report, it is hoped that it will remain as a continuing or standing committee of the Senate. The ever-changing conditions will require any formulation of science policy to be updated and provision must be made for its amendment. One of the most useful functions of a standing committee of the Senate would be to provide a mechanism for a meaningful dialogue between practising scientists and Parliament.

The majority of Canadian scientists have not yet become involved in the development of science policy and cannot do so effectively until

the results of current surveys, the recommendations of the Science Council, and those of this Committee and other competent authorities become available. When this information becomes available, it will be considered and digested by the membership of scientific societies, and strong response is to be expected. This assessment of the facts and consensus of opinion are likely to be useful to those formulating future policy but a mechanism must be provided for receiving and assessing this information at the highest level. Here a standing committee of the Senate would fill a valuable function.

Finally the Council wishes to make a general plea on behalf of the gifted young men and women who are to become the future scientists in Canadian biology. Science policy will not be complete unless provision is made to encourage the development of this most important resource. Money is needed certainly but more important are the policies that will create the right kind of environment to encourage and develop to the maximum their potential for discovery.

The brain drain is not an irreversible phenomenon as has been demonstrated recently by the reverse flow to Canada by Americans wishing to escape the consequences of conscription into the armed services; tacit evidence of the influence of government policies on resource distribution. The Council urges that careful consideration be given by the Federal Government to current and future studies in fields of training, development, and education of scientific manpower with a view to using the knowledge gained in total planning for Canadian science.

TABLE I

APPROXIMATE FEDERAL RESEARCH EXPENDITURES ON RESEARCH
IN BIOLOGICAL SCIENCE FOR THE FISCAL YEAR 1968-69

(in 000 \$)

| Source | Intramural | Industry | Universities (omitting scholarships etc.) | Total |
|----------|------------|----------|--|---------|
| EDA | 38,000* | - | 700 | 38,700 |
| FRB | 18,000* | 70 | 600 | 18,670 |
| Forestry | 15,000* | - | 600 | 15,600 |
| NRC | 6,650 | 600 | 14,900 | 22,150 |
| MRC | - | - | 21,500 | 21,500 |
| NH&W | 5,000 | - | 4,700 | 9,700 |
| TOTAL | 82,650 | 670 | 43,000 | 126,320 |

* About 20% of these expenditures are for non-biological items, see text.

BIOLOGICAL COUNCIL OF CANADA

MEMBER SOCIETIES

Canadian Association of Anatomists
L'Association Canadienne des Anatomistes

Canadian Biochemical Society
Le Société Canadienne de Biochimie

The Canadian Botanical Association
L'Association Botanique Canadienne

The Canadian Physiological Society
La Société Canadienne de Physiologie

The Canadian Phytopathological Society

Canadian Society of Microbiologists
Société Canadienne des Microbiologistes

The Canadian Society of Plant Physiology
La Société Canadienne de Physiologie Végétale

Canadian Society of Wildlife and Fishery Biologists
Société Canadienne des Biologistes de la Faune

Canadian Society of Zoologists
Société des Zoologistes Canadiens

Entomological Society of Canada
Société Entomologique du Canada

The Genetics Society of Canada
La Société du Génétique du Canada

The Pharmacological Society of Canada
La Société de Pharmacologie du Canada

The Nutrition Society of Canada
La Société Canadienne de Nutrition

Canadian Society for Cell Biology
Société Canadienne de Biologie Cellulaire

1968-69

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1969-70

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ESC Committee Brief on Future Needs of Entomological Research
in Insect Ecology (W.G. Wellington).

Committee: W.G. Wellington, E.J. LeRoux(Convenor), C.E. Atwood.

There is an urgent need today to increase our production of food and fibre. But the need to reduce the rate at which we have been polluting our environment is equally urgent. Wasteland is an inimical to human life as famine.

The presence of insect pests in the fields and forests has made it difficult for us to protect the plants we need without adding further chemical burdens to the lands and waters, because without some chemical treatment, insects claim a major share of our produce. Until recently, in fact, the problem seemed intractable. Now, recent advances in pesticide chemistry, on the one hand, and some concepts emerging from current research in the environmental and biological sciences, on the other, suggest that we need not invariably pollute our own living space to increase our share of the crops we grow.

Concepts are not applicable principles, however, and before principles can be applied they must be elucidated-- a process that requires a concerted research effort. In view of the urgency of the problem, the Entomological Society of Canada believes that research effort should be organized immediately. Of the many disciplines that must be involved, ecology occupies a central position, for it deals with the interactions of organisms with their environment, and the consequences of those interactions for specific populations and for whole communities. Thus in any programme aimed at increasing the numbers of desirable organisms and reducing the

ESC Committee Brief

numbers of pests, ecology is the clearing house where the fruits of pesticide and pollution research, and all the applicable principles drawn from insect physiology, biochemistry, and genetics are exchanged, examined, synthesized, and transmitted to the economic entomologist.

As in many other sciences, however, so in ecology: there are too few trained ecologists for the many agencies and institutions that require them. The costs and duration of their training are comparable to those for other biological students specializing in field studies-- a minimum of five years from Bachelor's to Ph.D., averaging \$5000 per student per year in direct costs for personal support and research programme maintenance. Consequently, in view of the limited funds available, the Society believes that a graduate training programme would be less costly, and much more effective, if it were coupled with an increased research effort on the fundamental aspects of our environmental problems, with most of that effort concentrated in the few Canadian centres where ecology is already emphasized.

There is, in fact, an urgent need for encouraging further growth in such university centres. Our knowledge is deficient in two areas where our problems are most demanding. For example, present knowledge of the processes that govern the rise and fall in animal numbers is woefully inadequate for the task of manipulating real populations. The theory of population regulation must be improved before economic entomologists can improve their ability to manipulate pest populations with acceptable consistency. Secondly, we need a better understanding of the real biological consequences when we disrupt natural systems, as we must in agriculture and in forestry. The techniques of systems analysis and computer technology must be exploited to speed the analysis and simulation

ESC Committee Brief

of sequential happenings that follow disturbance in different ecosystems, to help us predict and therefore avoid catastrophic consequences. In other words, we need to encourage development of research centres where two sets of principles can be elucidated as rapidly as possible: those principles that increase our knowledge of natural processes-- the fundamentals-- and those principles that deal with resource management techniques; i.e., the "principles of application".

These are tasks for which existing university centres for ecological research are well suited, and both tasks also fit easily into a programme for graduate training in ecology. Two kinds of financial support are required to develop the whole programme: (1) an increase in the amount available for direct support of graduate students, so that their number can be increased; (2) additional support for the ecological research programmes of the universities at which those students will study. Research support should include funds for staff additions as well as for equipment, field research, and computer time.

It is seldom desirable to separate insect ecology from the broader field of ecology, but for present purposes the Society has estimated the short-term minimum requirement for new insect ecologists alone: 30 trained Ph.D's by 1974, 24 more than the expected output during that period. In direct costs, 24 additional graduate students would require \$120,000 extra funding per year between 1969 and 1974. Five new academic staff members should be added to the universities involved during the same period, and they, their technical staff and their equipment and research needs would require an additional \$200,000 per annum. In addition, some 15 existing academic staff who would be directly involved in the increased

ESC Committee Brief

research and training programme should receive stronger support for the increased programme than current granting systems generally can provide. Model-building and simulation programmes run with the aid of computers are particularly costly-- an additional \$225,000 divided among fifteen investigators each year would enable them to expand their computer programmes, add essential equipment, and intensify their field and laboratory studies. During the five-year period, therefore, total additional funding for the whole programme would amount to \$545,000 per annum.

The Society recommends that these additional funds be allocated to not more than four universities that already have strong graduate schools in the biological sciences, especially in the ecological disciplines, and that are located in regions where each can exploit particular ecosystems in developing further their own research and training programmes. This approach would encourage more rapid advances in ecological theory by allowing different groups to develop and test their ideas within different ecological contexts, a more realistic approach than total concentration of the research effort in one centre could provide. For example, the Prairie region ecosystems differ markedly from those of the West Coast, and the biometeorology of Ontario raises different problems than those arising in Eastern Canada. Such differences must be taken into account.

There is always a delay between the discovery and the application of new principles in every field of science. But the global problems arising from our own population increase are so ominous that we can ill afford further delay in countering them. The Entomological Society of Canada therefore earnestly recommends that all possible support be given to the development of the research and training programme in insect ecology outlined in this brief.

APPENDIX 102

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

THE CANADIAN SOCIETY OF MICROBIOLOGISTS

BRIEF PREPARED BY THE
CANADIAN SOCIETY OF MICROBIOLOGISTS
FOR SUBMISSION TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
TO THE
SENATE OF CANADA

Summary

The Canadian Society of Microbiologists supports the thesis that the development of an overall and comprehensive Science Policy with a carefully designed and fully matured plan for securing national efficiency is essential to the development of Canada.

Education in all its stages and in all its phases from the highest cultural development to the most practical industrial training must be given high priority. The Universities must be properly articulated with other educational facilities within each Province and the Provincial systems of Education coordinated and organized into a workable National mechanism.

There should also be Government incentives to the development of research activities by Industry with the objective of developing industrial processes of our own that would feed the Canadian economy. Intensive studies of the activities of micro-organisms will lead to the discovery of unique reactions with industrial and commercial applications. This will involve the more dynamic use of microbiology in furthering the economic transformation of our primary national resources and in the conservation and disposal of wastes resulting from industrial development and urbanization.

Governmental support of a few specialized Research Institutes for the carrying out of work requiring relatively short term answers and an improved mechanism for the freer exchange of professional personnel are envisaged.

The development of a Canadian Post-Doctorate Fellowship scheme is outlined.

It is suggested that consideration might be given to the question of supporting National Scientific Societies in their endeavours to facilitate scientific communication between its English and French speaking members.

Special Committee

1. The Canadian Society of Microbiologists has given careful consideration to the question of submitting a Brief to the Special Committee on Science Policy of the Senate of Canada. Many of its members through their association in Government, Industry, Research Institutes, Universities, and other learned Societies have been active in the preparation and submission of Briefs on behalf of other bodies for your consideration, and there has consequently developed a feeling that the contributions already made by many of our members might well serve the purposes of our Society and that a separate Brief from us would be of little value to the deliberations of your Committee.

2. The Executive of our Society wishes to emphasize that conscious as we are of the comprehensive nature of certain of these submissions by other bodies we should in the light of your letter of January 10, 1969 take the opportunity of participating in this important national debate and in so doing confine ourselves to stressing the significance of the underlying unifying principles which brought our Society into existence and which as it has developed have served to distinguish it from any other organization in Canada which deals with microbic life and its effects; that we should record and give particular emphasis to the contributions we feel our Society has already made to the development of a Science Policy for Canada through the peculiar and unique qualities its members have given to it as a corporate body; and further that we should indicate the broad principles which we believe would lead to a structural organization of a Science Policy for Canada in which the science of microbiology would make a more effective contribution to the welfare of Canadians and our economy.

3. The Canadian Society of Microbiologists was founded in 1951 and will be holding its 19th Annual Meeting at the University of Ottawa on June 5, 6 and 7, 1969. A list of those who have held the office of President is to be found in the Directory

of the Society submitted as Appendix A. This list is indicative of one of the unique qualities of our Society to which reference has been made earlier. Our Society in a peculiar way has brought together a great diversity of people with wide interests and has enabled it to develop an internal flexibility and a dynamic organization which has provided a scientifically stimulating environment for its participation as a Society in a wide range of activities at various levels of organization--regional, national, and international. The structural organization of our Society recognizes the great diversity of individualities, interests and motivations of its membership. Its Councillors are representative of various aspects of Medical, Agricultural and Industrial Microbiology and of several aspects of a closely related science--Biochemistry.

4. Whereas Microbiology began in Agriculture and Medicine with an empirical and applied outlook it is now a science in its own right and the study of microorganisms is now contributing new techniques and ideas to the concepts of modern biochemistry and genetics. Microbiology is making contributions to the fundamental concepts of Biology through many of its multi-disciplinary studies on interactions, i.e. between viruses and host cells and on the symbiotic relations of microorganisms to Plants and Animals including Man.

5. Our Society has not drawn sharp distinctions between the pure and applied aspects of our activities. We emphasize those phases of our work in which we are peculiarly qualified to be of service and view our special problems by the clear light of fundamental biological principles. We appreciate our responsibilities for our heritage and that we must conserve our national resources intelligently. We recognize that our Society has on the one hand a highly cultural developmental role and on the other that it has a function to be concerned with the most utilitarian practical problems of application; that we must be

conscious of the economic significance as well as social values of our scientific undertakings.

6. The Society has an elected membership of approximately 675 members in good standing. It has Assets in Bonds, Investment Funds and a Bank Balance indicative of the interest of the membership in its overall activities and welfare.

The Society among its activities other than the Annual Meeting at which papers and symposia are presented offers a \$500 award to a Canadian citizen who has done outstanding work in the field of Microbiology. This is an Annual Award if a suitable nominee is available. The name of the recipient of this Award is announced at the Annual Meeting of the Society and is followed by an address delivered by the recipient.

The Society gives support to the Biological Council of Canada and has as its Representatives on this Council, Dr. Armand Frappier, Director of the "Institut de Microbiologie et d'Hygiène de l'Université de Montréal" and Dr. R. G. E. Murray, Head of the Department of Bacteriology and Immunology of the University of Western Ontario. Dr. A. C. Blackwood, of the Department of Microbiology, Macdonald College, McGill University and Dr. Vincent Portelance of the "Institut de Microbiologie et d'Hygiène de l'Université de Montréal" serve as Alternates.

The Society has devoted great effort towards the establishment and building up of the Canadian Journal of Microbiology--a well recognized medium of scientific communication attracting papers of international significance. It has provided 69 Universities in Developing Countries with gift subscriptions to its Journal--an activity of the Society which has met with a very favourable response.

The Society renders financial assistance to Regional Branches enabling them to obtain by travel subsidy outside speakers of distinction.

The Society has prepared and distributed an illustrated publicity brochure on "Careers in Microbiology--La microbiologie et votre avenir" a copy of which is submitted as Appendix B.

Each member of the Society has received a copy and 100 copies have been made available to each Provincial Department of Education. Additional copies are available at cost (40 cents each).

The Society publishes twice yearly a "News Letter--Bulletin de Nouvelles" with information about the affairs of the Society and related matters of interest to its members.

7. In its endeavours to promote the advancement of microbiology and the interchange of ideas between its members, the Society of set purpose holds its Annual Meetings at various centres in Canada. These meetings through the years have established a tradition of integrating formality and informality difficult to define but in which its members take great pride. In spite of the attractions of affiliation with the Canadian Federation of Biological Societies the Canadian Society of Microbiologists has to date elected to maintain its own individuality and integrity. A committee of the Society is presently studying this question and another committee is giving consideration to proposed changes that might be made in our internal structural organization which might serve to strengthen the Society in the light of recent developments in emphasis on the interrelationships between pure and applied aspects of our science and of the changing role of Government, Industry, and University associated with the problems of education, research and development.

The Society has recognized from its inception the problem of language communication and has endeavoured to facilitate scientific communication between its English and French speaking members. In the development of an overall Science Policy for Canada consideration might be given to the question of the support of National Societies in their endeavours to further this objective through support of the costs of simultaneous translation at meetings, translation of programs, news letters and summaries of publications in scientific journals.

8. The Canadian Society of Microbiologists supports the thesis that the development of an overall and comprehensive Science Policy with a carefully designed and fully matured plan for securing national efficiency is essential to the development of Canada. A definite coordinated plan of procedure to hasten the solution of real and pressing economic, social and political difficulties is required if we are to generate currents of scientific progress.

Education in all its stages and in all its phases from the highest cultural development to the most practical industrial training must be given high priority. The Universities must be properly articulated with other educational facilities within each Province and the Provincial systems of Education coordinated and organized into a workable National mechanism.

Centres of excellence in depth and in specialized phases of Microbiology for the education at the graduate level of our own talented graduates must be supported at the Universities if we are to utilize the potential of the microbial world in contributing to our welfare and economy.

There should also be Government incentives to the development of research activities by Industry to the end that there should be closer cooperation between microbiological research and industrial technology with the objective of developing industrial processes of our own that would feed the Canadian economy. Intensive studies of the activities of microorganisms will lead to the discovery of unique reactions with industrial and commercial applications. This will involve the more dynamic use of microbiology in furthering the economic transformation of our primary national resources and in the conservation and disposal of wastes resulting from industrial development and urbanization.

There should also be governmental support of a few specialized Research Institutes of Microbiology where major concern is the performance of applied and developmental research into problems requiring relatively short term answers. The work of these

Institutes must be coordinated with the teaching and research activities of Universities as well as with Governmental and Industrial Laboratories. This presupposes an improved mechanism for the freer exchange of professional personnel between Universities, Research Institutes and Laboratories of Government and Industry.

The development of a Canadian Post-Doctorate Fellowship scheme providing for Visiting Scientists to spend a one or two year period of tenure at Canadian Universities, Research Institutes, Government and Industrial Laboratories would assist in the strengthening of centres of excellence in specialized phases of Microbiology as they are developed.

Dr. C. E. Chaplin, Secretary-Treasurer,
Canadian Society of Microbiologists,
Canada Department of Agriculture,
Central Experimental Farm,
Ottawa, Ontario, Canada.

APPENDIX 103

BRIEF SUBMITTED TO
THE SENATE SPECIAL COMMITTEE ON
SCIENCE POLICY
BY
THE CANADIAN BIOCHEMICAL SOCIETY

Submission by the Canadian Biochemical Society to
the Senate Special Committee on Science Policy

Summary:

1. The Canadian Biochemical Society represents the majority of the research biochemists in Canada.
2. Biochemistry is an interdisciplinary science which utilizes chemical and biological concepts and techniques as well as innovations of its own.
3. The healthy growth of biochemistry in Canada should be sustained to take full advantage of the unique opportunities now offered for significant advances in fundamental knowledge and its application.
4. Competent biochemical research in all university departments should be supported at adequate levels.
5. Fundamental, as well as applied research, should be supported in institutions other than universities.
6. Major industrial corporations with biochemical orientations should be encouraged to establish substantial research laboratories in Canada.
7. Science policy-making bodies should include scientists who are directly involved in research, and national scientific societies should be consulted with regard to appointments to these bodies.

8. In our judgement, the creation of a central, science-policy making authority is not now in the best interests of Canadian biochemistry.

I. The Scope and Operations of the Canadian Biochemical Society:

The Canadian Biochemical Society was founded in 1958 to foster the science of biochemistry in Canada. It elects to Ordinary Membership persons who through scholarship or research have demonstrated an interest in biochemistry, and to Student Membership persons who are doing post-graduate research towards a Masters or Doctorate degree. Our present membership is approximately 600, of which 90 are Student Members.

Ordinary Members are drawn from the staffs of universities and colleges, clinical research institutes, government research laboratories, and industrial research laboratories. More than 90% of our members are resident in Canada, and they comprise the majority of active, research biochemists in the country.

The Society's main role has been to improve communications among biochemists, particularly at the research level. To this end we meet annually with the Canadian Federation of Biological Societies to exchange several hundred reports of original research. We also sponsor regular symposia on topics of special interest and an award for meritorious research by

young biochemists in Canada. The Society publishes a quarterly Bulletin for its members and periodically compiles an exhaustive "Directory of Biochemical Training and Research in Canada" (the 1968/69 issue is appended). At present we are also engaged, together with representatives of biochemical societies from the United States, the West Indies, and Latin America, in setting up a Pan-American Association of Biochemical Societies to promote communication among all biochemists in North and South America.

The affairs of the Society are conducted by an unpaid Council which is elected annually. Our operating expenses are paid for entirely by the members' dues, except for occasional grants and donations for specific purposes such as symposia and awards.

II. The Scope and Interdisciplinary Nature of Biochemistry:

Biochemistry, as its name implies, is concerned with the chemistry of living organisms and with the molecules and processes which distinguish life. It has two dominant themes. One is complexity. The other is unity: the cells of a man, a bee, a wheat seedling, a yeast and a bacterium are not identical, but most of the things which they do to maintain life are done by similar molecules organized in similar ways. Thus, a

discovery which illuminates the biochemistry of a yeast cell, for example, is very likely to illuminate the biochemistry of a man. Usually a novel problem is approached first through a relatively simple model system, later advancing to more complex organisms with more obvious bearing on man and his needs.

Biochemistry has become far wider in scope than the branch of chemistry traditionally devoted to the study of natural products. Our discipline has its roots in classical chemistry, both organic and physical, and continually adapts new chemical methods to its particular problems, but many novel and radical methods and concepts have been developed independently by biochemists. Furthermore, biochemistry has become a basic unifying biological discipline, which is now practiced with great success in traditionally biological fields such as medicine, botany, zoology, genetics, and agriculture. Psychology and the other behavioural sciences are beginning to explore biochemical approaches to their problems.

Biochemistry cannot therefore be treated simply as a branch of either biology or chemistry - it lies at the junction of several disciplines. This is evident by the affiliations of the Canadian Biochemical Society. It is the largest of the seven societies constituting the Canadian Federation of Bio-

logical Societies, in which most societies have a biomedical emphasis. We also maintain a Liaison Committee with the Chemical Institute of Canada, and co-sponsor symposia with them. At present we are associated too with the Biological Council of Canada, a consulting group of 14 societies including those representing the more descriptive biological sciences. We share some interests with each of these organizations, but in honesty to our discipline we cannot delegate to any one of them the right to speak for biochemistry.

III. The Past Achievements and Future Prospects of Biochemistry:

During the past thirty years, biochemists have answered profound questions, such as the following:

How do living organisms obtain and transform the energy required to maintain life?

What are the chemical structures of the molecules, both small and large, in living cells, and how are they synthesized and regulated?

What features of these molecules determine their biological functions?

How is inherited information stored, reproduced and expressed by an organism?

These are impressive achievements which are still leading to

many results of the greatest practical importance in medicine and agriculture. But they are only a beginning.

Biomedical technology is still limited by our ignorance of answers to fundamental questions. For example:

How are molecules organized to form cells, tissues and organisms?

How are these systems of molecules controlled in normal cells, and how do these controls become deranged in diseases?

What is the biochemical basis of brain function, consciousness, and behaviour?

These problems, and others yet unformulated, form one of the last great frontiers in science - one of the few frontiers still open to scientists in countries like Canada which cannot command the resources of a super-power.

IV. The Present Status and Some Current Problems of Biochemistry in Canada:

Some idea of the range and emphasis of current biochemical research in this country can be obtained from the "Directory of Biochemical Training and Research in Canada", which accompanies this submission. The following sections consider some of the general problems.

1. Research in Universities:

Historically biochemistry in Canada was nurtured

first by the medical schools, partly because of its importance in medicine, but also because classical chemists were not attracted to the complex and seemingly intractable molecules present in living systems. Most Biochemistry Departments still remain in the Faculties of Medicine, where there are also growing numbers of biochemists in other departments. However, biochemists have become an increasingly substantial part of other faculties, contributing to the Biology and Chemistry Departments in Science Faculties, to Faculties of Agriculture and Home Economics, and even to Faculties of Engineering. Most post-graduate students of biochemistry receive their undergraduate training in chemistry, biology, joint or specialized programmes of Science Faculties.

Biochemical research in Canadian universities has been supported in various ways in the past few years and the sources of support may be summarized under three heads:

- (a) Foreign support: Substantial support has been received from the United States, largely in the form of research grants to individuals from Federal agencies such as the National Institute of Health or the National Science Foundation. This support reached a maximum some 5-7 years ago but has declined substantially in the last 2-3 years and

is now no longer of major importance. It is essential that this slack is taken up by our own indigenous sources of support.

- (b) Private Foundations in Canada: Considerable support for biochemical research, particularly that with a medical orientation, has come from private foundations such as the National Cancer Institute, the Heart Foundation, the Canadian Arthritis and Rheumatism Society, the Muscular Dystrophy Society, the Life Insurance Medical Fund and many others. While this support has played, and still plays a vital role, the great expansion of biochemical research in the universities has far outrun the means of these private agencies.
- (c) Provincial Government Support: Although conditions vary from province to province, in general, Provincial governments do not support a substantial amount of biochemical research. Such support as is given usually emphasizes undergraduate and graduate student training.
- (d) Federal Government Support: By far the most substantial support has come from the Federal Government and it seems clear that federal support must finance

an increasing proportion of biochemical research in the future. The federal agencies support most of the university research, the National Research Council and the Medical Research Council being the major granting bodies with lesser supplements from other government agencies.

The Table on page 4 of the Directory gives an estimate of the Operating and Major Equipment Grants for biochemical projects in Canadian universities in 1968/69.

In recent years, funds available to the Medical Research Council have grown rapidly and support of biochemical research in departments within Medical Faculties has reached levels which approach adequacy and are becoming comparable to the support received by biochemists in the United States. The results have been good - several of our universities now have biochemistry departments of high calibre where work of international standing is being done. It is the opinion of our Society that the Medical Research Council deserves much credit for its enlightened support of fundamental biochemistry and its lack of insistence upon medical mission-oriented work. In

addition, M.R.C. has developed a thorough and objective method of appraising research proposals in which qualified referees are consulted to ensure that funds are channeled only into worthwhile projects. Unfortunately the same level of support has not been available to biochemists in non-medical faculties, although these include some of our most promising researchers. Generally they must rely on the National Research Council for support, and, although the policies and standards of N.R.C. Grant Selection Committees have been under revision, the funds for biochemistry have been more restricted. Thus work of top quality outside a medical school is often supported at a substantially lower level than comparable work in a Medical Faculty.

To eliminate this damaging double standard in Canadian universities, we recommend that support for biochemical research in all university departments be brought up to an adequate level - either by widening the scope and supplementing the resources of M.R.C., or by increasing the granting resources of N.R.C.

2. Research in Other Institutions:

About one-fifth of the Ordinary Members of the Canadian Biochemical Society work in government or industrial research laboratories. A similar number are in hospital or private research laboratories, often with loose university affiliations.

It has been asserted that fundamental research should be confined to teaching institutions (Science Council of Canada, Report No. 4, p. 23). In fact, most scientists in government and private laboratories have considerable liaison with university students and teachers, and these laboratories serve as a fluid pool of experienced personnel entering and leaving the teaching faculties. It is healthy for scientists in both types of institution to have these alternative types of employment to satisfy their changing needs.

Furthermore good research workers do not necessarily make good teachers, nor do all fundamental research projects lend themselves to the training or pre-doctoral students. Some of the most valuable contributions to biochemical knowledge have come from laboratories, both here and abroad, in which teaching was at most a secondary role. A pertinent example is the past year's Nobel Laureate in Medicine, Dr. H. G. Khorana of the University of Wisconsin, who spent

many of his most productive years (1952-59) on the staff of the British Columbia Research Council in Vancouver.

If the recommendations of the Science Council concerning fundamental research in Federal laboratories (Science Council Report No. 4, p. 26) were to be adopted, we recommend that alternative environments be provided in which basic research could thrive as the primary activities of able scientists. Perhaps such facilities might be decentralized to make them accessible to more university scientists and students, but it has often been asserted that complete segregation of fundamental and applied researchers (e.g. in universities and government laboratories) would lead to a decline in the quality of the work of both.

A disturbing feature of the Canadian biochemical scene is the meager level of industrial research by companies dependent on biochemically-oriented research and technology. A few companies have made a commendable effort to foster original research in Canada, but too many have not. This is commonly attributed to the fact that many Canadian companies are operated as "branch plants" of large corporations based in the United States, where their research facilities are concentrated. However there are indications that many international corporations are decentralizing their research

operations. For example a Swiss pharmaceutical company shortly will be opening an "Institute of Molecular Biology" in New Jersey in order to combine their own experience with the American strength in fundamental biochemistry.

Canada should also be in a good position to attract such enterprise. In our favour we have a relatively stress-free social climate, good universities and a growing number of trained graduates who wish to remain in Canada. We must supplement these attractions with a biomedical research environment of a calibre which will be recognized abroad. By means of inducements, persuasion and example we should maintain pressure for participation in research by those who benefit from the Canadian market.

v. National Science Policy:

In recent years, much effort has been devoted to finding new means by which Federal government policy should be determined. Yet we who are most concerned, the research scientists and their chosen representatives in national scientific societies, have been little consulted. In our opinion, one of the most important attributes at the council table - the ability to see beyond the immediate scientific horizon - is most likely to be found among those who are directly involved in research and thus closer to that horizon. Thus at least some

of those who are called upon to advise the government on science policy should surely be men or women who are noted for their scientific achievements. If participatory democracy is to have meaning, we contend that our national societies should be consulted before such scientists are appointed.

Biochemical research has derived much of its strength from the fact that it is basic to many other biological and medical disciplines and thus has been encouraged by a variety of agencies. We hope that this healthy situation is allowed to continue for we have serious misgivings about the efficacy of any central planning body which might try to blue print the future course of biochemical research in Canada.



Government
Publication

First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 53

WEDNESDAY, JUNE 4, 1969

WITNESSES:

The Royal College of Physicians and Surgeons of Canada: Dr. Jacques Turcot, President, Dr. Charles Drake, Vice-President, Dr. Ian Rusted, Vice-President, Dr. Robert B. Kerr, Immediate Past President, Dr. K. J. R. Wightman, Executive Member, Dr. James H. Graham, Secretary; The Association of Canadian Medical Colleges: Dr. Maurice LeClair, Vice President, Dr. John R. Evans, Dr. Maurice McGregor, Member; Canadian Society for Immunology; Dr. B. Cinader, President, Canadian Society for Clinical Investigation: Dr. C. H. Hollenberg, President, Dr. D. Wigle, Councillor; Canadian Physiological Society: Dr. J. W. Pearce, President; National Cancer Institute of Canada: Dr. J. H. Copp, President, Dr. R. M. Taylor, Executive Director; Canadian Association of Anatomists: Dr. Keith L. Moore, President; Association of Chairmen of Canadian Departments of Pathology (Medical Schools of Canada): Dr. A. C. Ritchie, President, Dr. D. Magner, Member; Medical Research Council: Dr. G. Malcolm Brown, Chairman.

APPENDICES:

- 104—Brief submitted by The Royal College of Physicians and Surgeons of Canada
- 105—Brief submitted by the Association of Canadian Medical Colleges
- 106—Brief submitted by the Canadian Society for Immunology
- 107—Brief submitted by Canadian Society for Clinical Investigation
- 108—Brief submitted by The Canadian Physiological Society
- 109—Brief submitted by The National Cancer Institute of Canada
- 110—Brief submitted by the Council of the Canadian Association of Anatomists
- 111—Brief submitted by the Association of Chairmen of Canadian Departments of Pathology (Medical Schools of Canada)

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère

Grosart
Haig
Hays
Kinnear
Lamontagne
Lang
Leonard
McGrand

Nichol
O'Leary (*Carleton*)
Phillips (*Prince*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, June 4, 1969

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 8.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Cameron, Carter, Grosart, Phillips (*Prince*), Robichaud, Sullivan, and Yuzyk—9.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*); Gilles Paquet, Director of Research, (*Human Science*).

The following witnesses were heard:

THE ROYAL COLLEGE OF PHYSICIANS AND SURGEONS OF CANADA

Dr. Jacques Turcot, President
Dr. Charles Drake, Vice President
Dr. Ian Rusted, Vice President
Dr. Robert B. Kerr, Immediate Past President
Dr. K. J. R. Wightman, Executive Member
Dr. James H. Graham, Secretary

THE ASSOCIATION OF CANADIAN MEDICAL COLLEGES

Dr. Maurice LeClair, Vice President
Dr. John R. Evans
Dr. Maurice McGregor

CANADIAN SOCIETY FOR IMMUNOLOGY

Dr. B. Cinader, President

CANADIAN SOCIETY FOR CLINICAL INVESTIGATION

Dr. C. H. Hollenberg, President
Dr. D. Wigle, Councillor

CANADIAN PHYSIOLOGICAL SOCIETY

Dr. J. W. Pearce, President

NATIONAL CANCER INSTITUTE OF CANADA

Dr. J. H. Copp, President
Dr. R. M. Taylor, Executive Director

CANADIAN ASSOCIATION OF ANATOMISTS

Dr. Keith L. Moore, President

ASSOCIATION OF CHAIRMEN OF CANADIAN DEPARTMENTS OF PATHOLOGY (Medical Schools of Canada)

Dr. A. C. Ritchie, President
Dr. D. Magner, Member

MEDICAL RESEARCH COUNCIL

Dr. G. Malcolm Brown, Chairman

(A curriculum vitae of the witnesses follows these Minutes.)

The following are printed as Appendices:

No. 104—Brief submitted by The Royal College of Physicians and Surgeons of Canada

No. 105—Brief submitted by Association of Canadian Medical Colleges

No. 106—Brief submitted by the Canadian Society for Immunology

No. 107—Brief submitted by the Canadian Society for Clinical Investigation.

No. 108—Brief submitted by The Canadian Physiological Society

No. 109—Brief submitted by the National Cancer Institute of Canada

No. 110—Brief submitted by the Council of The Canadian Association of Anatomists

No. 111—Brief submitted by the Association of Chairmen of Canadian Departments of Pathology (Medical Schools of Canada)

At 11.15 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Brown, G. Malcolm Born in Campbellford, Ontario, July 16, 1916 Education: M.D., C.M., Queen's University, 1938 Rhodes Scholarship 1938 D. Phil., Oxon, 1940 Research Scholar, Radcliffe Infirmary, 1941-43 Higher Professional Qualifications: M.R.C.P. (London), 1943; F.R.C.P. (C), 1946; F.A.C.P., 1949; F.R.C.P. (London), 1961; F.R.S.C., 1966 Military Service: R.C.A.M.P., England and Northwest Europe 1943-46 University Appointments: Queen's University: Associate Professor of Medicine, 1946-51 Professor of Medicine, 1951-65 Member of Senate, 1949-52 Member of University Council, 1949-52 Member of Board of Trustees, 1966- University of Ottawa: Professor of Medicine, 1965- Hospital Appointments: Kingston General Hospital: Attending Physician, 1946-65 Director, Clinical Investigation Unit, 1961-65 Kingston Military Hospital: Consulting Physician, 1946-65 Department of Veterans Affairs, Kingston District: Chief of Service—Medicine, 1946-65 Ottawa General Hospital: Attending Physician, 1965- Ottawa Civic Hospital: Consulting Physician, 1965- Scientific and Professional Societies: College of Physicians and Surgeons of Ontario—Member of Council 1949-58 President 1956-58 Royal College of Physicians and Surgeons of Canada—Member of Council 1954-58 and 1960-66 Member of Executive 1956-58, 1964-66 President 1962-64 American College of Physicians—Regent 1965- Canadian Foundation for the Advancement of Therapeutics—Director 1963- National Cancer Institute of Canada—Representative Member 1965 Ontario Cancer Treatment and Research Foundation—Member, Advisory Medical Board 1966- Muskoka Hospital Memorial Research Fund—Chairman, Research Committee 1965- Member, Advisory Panel of the CIBA Foundation, London, England, 1966- Fellow, Royal Society of Canada Member: American Society for Clinical Investigation American Federation for Clinical Research American Society of Hematology Canadian Association of Gastroenterology Canadian Physiological Society Canadian Society for Clinical Investigation Member: Ontario Medical Association Canadian Medical Association International Society of Hematology American Clinical and Climatological Society Government Agencies: Defence Research Board—Panel on Arctic Medical Research Member 1947-54 Chairman 1952-54 Defence Research Board—Panel on Nutrition Member 1952-58 Defence Research Board—Defence Medical Research Coordinating Committee Member 1967- Department of National Health and Welfare—Canadian Council on Nutrition—Member 1950-54 National Research Council—Member 1965- Medical Research Council 1960- Member of Executive 1961- Chairman 1965- Science Council of Canada—Member 1966- Publications: Seventy-odd papers in scientific journals in the fields of malaria research, cold physiology, hematology and gastroenterology.

Cinader, Bernhard. Born: March 30, 1919, Vienna, Austria. Education: B.Sc. University of London, England, 1945; Ph.D. in Biochemistry, University of London (Lister Institute of Preventive Medicine), England, 1948. Distinctions: Old Students Prize (Queen Mary College, University of London), 1944; Jenner Memorial Studentship, 1946; Beit Memorial Fellowship for Medical Research, 1949; Lecturer and Medallist of the Société de Chimie Biologique (Paris), 1954; Director of the Section of Immunochemistry, 4th World Congress of

Biochemistry, 1958; D.Sc. University of London, England, 1958; Special Lecturer, Institut Pasteur, Paris, 1960; Fellow, New York Academy of Sciences, 1963; Public Lecturer University College, London (U.K.), 1963; Enrique E. Ecker Lecturer in Experimental Pathology, Western Reserve University, 1964; Director of Immunochemistry-Section: 2nd Meeting of the Federation of European Biochemical Societies, 1965; Chairman of the Canadian Society for Immunology, 1966; Invited Lecturer at the VI International Congress for Clinical Chemistry, Munich, Germany, 1966; Fellow of the Royal Institute of Chemistry, (U.K.), 1967; President, Canadian Society for Immunology, 1967-1969. Experience: 1945-46, Research Assistant, Lister Inst. of Preventive Medicine, London, England; 1946-48, Jenner Memorial Student, Dept. of Biophysics, Lister Inst. of Preventive Medicine, London, England; 1948-49, Fellow of Immunochemistry, Institute of Pathology, Western Reserve University, Cleveland, Ohio, U.S.A.; 1949-53, Beit Memorial Fellow, Lister Inst. of Preventive Medicine, London, England; 1953-56, Grantee of the Agricultural Research Council, Lister Inst. of Preventive Medicine, London, England; 1955, Research work at the Institut Pasteur, Paris, France; 1956-58, Principal Scientific Officer, Dept. of Experimental Pathology, Institute of Animal Physiology, (A.R.C.), Babraham Hall, Cambridge, England, and honorary lecturer in the Biochemistry Dept. of University College, London, England; 1958, Head, Subdivision of Immunochemistry, Division of Biological Research, Ontario Research Institute, Toronto, Ontario and Associate Professor, Departments of Medical Biophysics and Pathological Chemistry, University of Toronto; 1960-65, Training Director, N.I.H. Training Grant 5TI GM 506-03 (post graduate research training); 1962, Conference Chairman of Symposium: Antibody to Enzymes, a Three-component System, New York Academy of Sciences; 1965, Organizer of Symposium: Antibodies to Biological Active Molecules, Federation of European Biochemical Societies, Vienna, Austria; 1965, Editorial Board: Immunochemistry; 1966, Conference Chairman of Symposium: Regulation of the Antibody Response, Toronto, Canada; Lecturer at the McGill University Laurentians Summer School on "Molecular and Cellular Aspects of Immunobiology"; 1966, Member of the Grant Panel of Epidemiology, Immunology, Microbiology, Pathology and Virology, National Cancer Institute of Canada, Member of the Editorial Board of *Excerpta medica* foundation, Immunology, Serology and Transplantation Section; 1967, Visiting Professor, University of Manitoba; Member of the Committee of the American Association of Immunologists for post graduate education and International Congress; Chairman, Immunology Committee, Biological Council of Canada; Section Chairman of Rutgers—The State University, New Brunswick, N.J.; Symposium on "Nucleic Acids in Immunology" and of the 6th Congress of the International Association of Allergology, Montreal, P.Q., Canada; Professor, Department of Medical Biophysics, University of Toronto; Editorial Board, Canadian Journal of Biochemistry; Member of the Grant Panel of the Medical Research Council (Canada); Member of the Medical Research Council Committee on Antilymphocytic Serum; 1968, Visiting Professor, University of Alberta; Member of the Subcommittee on Contract Research of the Antilymphocytic Serum Project, Medical Research Council (Canada); Member of the Medical Sciences Building, Animal Facilities Committee, University of Toronto, Toronto, Canada; Chairman, Library Committee, Ontario Cancer Institute, Toronto; Chairman of Sessions: International Convocation on Immunology, State University of New York at Buffalo; 5th Meeting

of the Federation of European Biochemical Sciences, Prague, Czechoslovakia; The Gordon Research Conference on Immunochemistry and Immunobiology, Meridan, New Hampshire, U.S.A.; International Conference on Immunological Tolerance, National Institutes of Health, Augusta, Michigan, U.S.A.; Chairman of Symposium: "Cellular and Molecular Aspects of the Immune Response", Canadian Society for Immunology, Canadian Federation of Biological Societies, Queen's University, Kingston, Ontario, Canada; Invited Lecturer: New York University Medical Center, New York; St. Mary's Hospital Medical School, University of London, England; 5th Meeting of the Federation of European Biochemical Societies, Prague, Czechoslovakia and Dalhousie Medical Centenary, Dalhousie University, Halifax, Nova Scotia; Chairman and Lecturer of Session "Immunogenetics" Medical Genetics, A short course in human heredity and disease, Toronto; 1969, Organizer and Symposium Chairman, "Immuno-suppressive Agents and Chemotherapy", 5th Annual Meeting of the Canadian Society of Chemotherapy, Toronto; Organizer and Symposium Chairman, "Genetics of the Antibody Response" in the Colloquium Protides of the Biological Fluids, Brugge, Belgium; Elected Faculty Member (Division IV) of the School of Graduate Studies, University of Toronto; Professor, Cell Biology Group, University of Toronto; Member of "Speciality Committee" in Clinical Immunology, The Royal College of Physicians and Surgeons of Canada; Elected Chairman of the International Union of Immunological Societies.

Copp, D. Harold: Born in Toronto, Ontario, January 16, 1915. Education: B.A., Biological and Medical Sciences, 1936, M.D., 1939, University of Toronto, Ph.D., Biochemistry, 1943, University of California Berkeley. University Appointments: Assistant Professor of Physiology, University of California Berkeley, 1943-50, Professor and Head, Department of Physiology, University of British Columbia 1950-. Scientific and Professional Societies: Fellow, Royal Society of Canada. National Cancer Institute of Canada: Member 1956-, Board of Directors 1961-, President, 1968-. Canadian Physiological Society, President 1963-64. Faculty Association University of British Columbia, President 1965-66. Gordon Research Conference on Bone and Teeth, Chairman 1957. Government Agencies: National Research Council, Chairman of Associate Committee on Dental Research 1957-59, Defence Research Board, Panel on Radiation Protection and Treatment, Member 1952-62, Chairman 1957-59. Member of Special Committee to Review Extra Mural Support of Medical Research in Canada (Farquharson Committee) 1959, Member of Medical Research Council Study Group 1968-. International Agencies: Second United Nations Conference on Peaceful Uses of Atomic Energy, Scientific Secretary 1956. Publications: Seventy publications on physiology of the bone. Awards: University of Toronto Science Medal 1936, Gold Medal in Medicine 1939, Gairdner Foundation Annual Award 1967, Nicholas Andry Award of Association of Bone and Joint Surgeons 1968.

Drake, Dr. Charles G. of London, Ontario was born in Windsor, Ontario. He obtained his M.D. qualification from the University of Western Ontario in 1944 and an M.Sc. degree from the same university in 1947. He obtained his Fellowship in the Royal College of Surgeons of Canada by examination in 1952 in the specialty of Neurosurgery. Dr. Drake is Professor and Chairman of the Department of Clinical Neurological Sciences and Professor and Chairman of the Division of Neurosurgery at the University of Western Ontario. He is Chief

of Neurosurgery at Victoria Hospital in London, Ontario. Dr. Drake has been a Member of the Council of the Royal College since 1962 and is currently Vice-President of the College for the Division of Surgery.

Evans, John R.: Doctor Evans received his premedical and medical training at the University of Toronto, graduating in 1952. He spent three years as a Research Fellow at Oxford University, England and at the National Heart Hospital in London. In 1955 he was awarded the Doctor of Philosophy from Oxford University. Following clinical training in London, England and Toronto and further research experience at Harvard Medical School in Boston, he joined the staff of the University of Toronto in the Department of Medicine. In 1965 Doctor Evans came to McMaster University to initiate the development of the Faculty of Medicine and the programmes in Health Sciences. He now holds the appointment of Vice President—Health Sciences, Dean, Faculty of Medicine and Professor in the Department of Medicine at McMaster University.

Graham, James Hutcheson: Born December 16, 1917 at Ottawa; University Degrees: M.D., C.M. (McGill University) 1942; Graduate Training: 1942-43, Interne, The Montreal General Hospital. 1943-44, Resident in Pathology, The Montreal General Hospital. 1944-45, Resident in Medicine, The Montreal General Hospital. 1945-46, Assistant Resident in Medicine, Peter Bent Brigham Hospital, Boston, Massachusetts. 1946-47, Resident in Medicine, Peter Bent Brigham Hospital, Boston, Massachusetts. Specialty Qualifications: Fellowship and Certification in Internal Medicine, The Royal College of Physicians and Surgeons of Canada, 1948. Practice: Internal Medicine—Ottawa, 1947-1966. Hospital Appointments: 1947 to present—Staff, Ottawa Civic Hospital Currently Senior Physician. Offices: 1953-56, Honorary Secretary, The Royal College of Physicians and Surgeons of Canada; 1956-66, Secretary (part-time), The Royal College of Physicians and Surgeons of Canada; 1966 to present, Secretary (full-time), The Royal College of Physicians and Surgeons of Canada.

Hollenberg, C. H. Born: Winnipeg, Manitoba, September 15, 1930; Degrees: B.Sc., University of Manitoba, 1950; M.D. and B.Sc. (Med), University of Manitoba 1955; F.R.C.P.(C), 1959. Academic-Research Training and Experience: 1954-55, Junior Interne, Medicine—Winnipeg General Hospital; 1955-56, Junior Assistant Resident, Medicine—Montreal General Hospital; 1956-57, Assistant Resident, Medicine—Montreal General Hospital; 1957-58, Assistant Resident, Medicine—New England Centre Hospital, Boston, Massachusetts; 1958-60, Research Fellow, Medicine—New England Center Hospital, Boston, Massachusetts. Academic Appointments: 1958-60, Assistant in Medicine, Tufts University; 1960-62, Lecturer in Medicine, McGill University; 1962-64, Assistant Professor of Medicine, McGill University; 1964-, Associate Professor of Medicine, McGill University. Hospital Appointments: 1960-61, Junior Assistant Physician, Montreal General Hospital; 1962-64, Assistant Physician, Montreal General Hospital; Assistant Director, McGill University Medical Clinic, Montreal General Hospital; 1964-66, Associate Physician, Montreal General Hospital; 1966-, Senior Physician, Montreal General Hospital. Present Appointments: Associate Professor of Medicine, McGill University; Director, Division of Metabolic Diseases, Montreal General Hospital. Awards and Scholarships: 1955, University of Manitoba Gold Medal in Medicine; 1960, Markle Scholar in the Medical Sciences. Societies: American College of Physicians (Associate),

American Federation for Clinical Research, American Physiological Society, American Society for Clinical Investigation, Canadian Biochemical Society, Canadian Society for Clinical Investigation (President), Endocrine Society, Royal College of Physicians and Surgeons (Canada).

FULL PUBLICATIONS

1. Raben, M.S. and Hollenberg, C.H. Effect of Growth Hormone on Plasma Fatty Acids. *J. Clin. Invest.* 38: 484, 1959.
2. Hollenberg, C. H. Effect of Nutrition on Activity and Release of Lipase from Rat Adipose Tissue. *Am. J. Physiol.* 197: 667, 1959.
3. Raben, M.S. and Hollenberg, C. H. Effect of Glucose and Insulin on the Esterification of Fatty Acids by Isolated Adipose Tissue. *J. Clin. Invest.* 39: 435, 1960.
4. Hollenberg, C. H. Effect of Fasting on the Lipoprotein Lipase Activity of Rat Heart and Diaphragm. *J. Clin. Invest.* 39: 1282, 1960.
5. Raben, M. S. and Hollenberg, C. H. Growth Hormone and the Mobilization of Fatty Acids. *Ciba Foundation Coll. Endocr.* 13: 89, 1960.
6. Hollenberg, C. H., Raben, M. S., and Astwood, E. B. The Lipolytic Response to Corticotropin. *Endocrinology* 68: 589, 1961.
7. Sheldon, H., Hollenberg, C. H., Winegrad, A. I. Observations on the Morphology of Adipose Tissue. *Diabetes*, 11: 387, 1962.
8. Hollenberg, C. H. Horowitz, I. The Lipolytic Activity of Rat Kidney Cortex and Medulla. *J. Lipid Research*, 3: 445, 1962.
9. Hollenberg, C. H. and Douglas, D. E. Effect of Adrenalin, Corticotrophin, Fasting and Diabetes on the Composition of the Long-Chain Fatty Acids of Rat Epididymal Fat. *Nature*, 193: 1074, 1962.
10. Hollenberg, C. H. The Effect of Incubation on the Characteristics of the Lipolytic Activity of Rat Adipose Tissue. *Can. J. Biochem. and Physiol.* 40: 703, 1962.
11. Hollenberg, C. H. and Angel, A. Relation of Fatty Acid Structure to Release and Esterification of Free Fatty Acids. *Am. J. Physiol.* 5: 205, 1963.
12. Hollenberg, C. H. Adipose Tissue Lipases II *Handbook of Physiology*, 1965.
13. Hollenberg, C. H. Transfer of Fatty Acids Between Triglyceride Species in Rat Adipose Tissue. *J. Lipid Research*, 6: 84, 1965.
14. Hollenberg, C. H. and Roncari, D. A. K. Adipose Tissue Metabolism and Obesity. *J. App. Therapeutics*. 7, No. 1, 1965.
15. Hollenberg, C. H. The Origin and Glyceride Distribution of Fatty Acids in Rat Adipose Tissue. *J. Clin. Invest.* 45: 205-216, 1966.
16. Lucis, O. J., Hobkirk, R., Hollenberg, C. H., MacDonald, S.A., Blahey, P. Polycystic Ovaries Associated with Congenital Adrenal Hyperplasia. *Can. Med. Assoc. J.* 94: 1-7, January 1, 1966.
17. Hollenberg, C. H. Distribution of Radioactive Glycerol and Fatty Acids Among Adipose Tissue Triglycerides After Administration of Glucose-U-14C. *J. Lipid Research*, 8: 328, 1967.
18. Roncari, D. A. K. and Hollenberg, C. H. Esterification of Free Fatty Acids by Subcellular Preparations of Rat Adipose Tissue. *Biochemica et Biophysica Acta*. 137: 446-463, 1967.

19. Hollenberg, C. H.—Editor Symposium on Obesity—Modern Treatment. Harper and Row, N.Y. Publishers, Vol. 4, No. 6. November, 1967.
20. Hollenberg, C. H. and Angel A. Adipose Tissue Metabolism and Obesity. Modern Treatment. Harper and Row, N.Y. Publishers. Vol. 4, No. 6, November, 1967.
21. Hollenberg, C. H. and Vost, A. Regulation of Adipose Tissue Mass. Origin of Adipose Lipid and Control of Fat Cell Formation. Excerpta Medica, Series 161. Third International Symposium on Protein and Polypeptide Hormones, Liege, Belgium, May 1968.
22. Hollenberg, C. H. and Vost, A. Regulation of DNA Synthesis in Fat Cells and Stromal Elements from Rat Adipose Tissue. *J. Clin. Invest.* 47: 2485, 1968.
23. Patten, R. L. and Hollenberg, C. H. The Mechanism of Heparin Stimulation of Rat Adipocyte Lipoprotein Lipase. *J. Lipid Research*—in press.
24. Hollenberg, C. H. The Training of the Physician Scientist. *Can. Med. Assoc. J.* 100: 603, 1969.

Kerr, Robert Bews: Was born in Hamilton, Ontario. He obtained a B.A. degree from the University of Toronto in 1930, an M.D. degree from the University of Toronto in 1933, and an M.A. degree, also from the University of Toronto in 1936. His postgraduate training was taken at the Toronto General Hospital and the Department of Physiology of the University of Toronto and subsequently at London Hospital in London, England and University College Hospital in London. He joined the staff of the Toronto General Hospital and the Faculty of Medicine of the University of Toronto in 1939. He rose to the post of Professor of Therapeutics at the University of Toronto but in 1950 left Toronto to become Professor and Head of the Department of Medicine at the University of British Columbia which post he has held since that time. Dr. Kerr served overseas with the Royal Canadian Army Medical Corps from 1940 to 1945 and was awarded the O.B.E. in 1945. He became a Member of the Royal College of Physicians in London in 1938 and a Fellow of that College in 1955. Dr. Kerr for some years has been a Fellow of the American College of Physicians and was recently made a Master of that College. He was a founding Member of the Canadian Society for Clinical Investigation, and he is currently President of the Medical Council of Canada. Dr. Kerr has served The Royal College of Physicians and Surgeons of Canada in many capacities; he has been a Member of the Council since 1960 and from 1966 to 1968 was President.

Leclair, J. Maurice: Born in Sayabec, Quebec, 1927. Education: B.Sc., McGill University, 1947 M.D., C.M., McGill University, 1951 M.Sc., University of Minnesota, 1958 Higher Professional Qualifications: F.R.C.P.(C); F.A.C.P., C S.P Q. Hospital Appointments: Hopital Notre-Dame, Montreal Attending Physician, 1958-65 University Appointments: University of Montreal Associate Professor of Medicine, 1962-64 University of Sherbrooke Professor and Chairman, Dept. of Medicine, 1965-68 Vice-Dean of Medicine, 1968—Scientific and Professional Societies: Royal College of Physicians and Surgeons of Canada—Co-chairman, Committee on Credentials Association of Internists of Province of Quebec—Secretary, 1962-65 National Cancer Institute of Canada—Member, Board of Directors Member: Alpha Omega Alpha Society; Canadian Medical Association;

Association de Médecins de la Langue française, Société médicale de Montréal, Montreal Medical-Chirurgical Society Member: American college of Physicians, Club de Recherche clinique de Québec, American Association for the Advancement of Science, New York Academy of Science Government Agencies: Medical Research Council—Member, 1967—Member, Executive Committee, 1968—Chairman, Grants Committee for Clinical Investigation, 1968—Publications: Sixteen papers in scientific journals in the fields of internal medicine and hematology.

Magner, Desmond: Born: Cork, Ireland, 5th January 1913. Married—December 27th 1944 to Miriam Margaret Anglin. Children: 8. Education: Upper Canada College, Toronto 1923-30, University of Toronto—M.D. 1936, B.Sc. (Med.) 1938. Military Service: Royal Canadian Army Medical Corps 1939-45. Rank on discharge: Lieut.-Col. Post-Graduate Positions: Intern—St. Michael's Hospital, Toronto 1936-37. Fellow in Pathology—Banting Institute, University of Toronto 1937-39. Lecturer in Pathology 1939-45 (leave of absence); Pathologist—Regina City Hospitals and Saskatchewan Cancer Clinic, Regina 1946-47. Professor and Head, Department of Pathology, University of Ottawa 1947. Registrar, Canadian Tumour Reference Centre, National Cancer Institute of Canada 1949. Member: Ontario Association of Pathologists, Canadian Association of Pathologists, American Association of Pathologists and Bacteriologists, International Academy of Pathology, Ontario Medical Association, Canadian Medical Association, Ottawa Academy of Medicine, Fellow of the Royal Society of Physicians and Surgeons of Canada.

McGregor, Maurice: M.B., B.Ch., M.D., F.R.C.P. (Lond.) F.R.C.P. (C). Born: March 24, 1919, South Africa. Education: (a) Secondary Michaelhouse, Matriculation, December, 1935 (South Africa). (b) University: University of Witwatersrand, Johannesburg, South Africa. Degrees: M.B., B.Ch. (Univ. of Witwatersrand) 1942 (Canadian equivalent, M.D.); M.D. thesis "Basilar Impression" accepted, University of Witwatersrand, 1947. Graduate Training: July 1945-January 1947. Internship, Johannesburg General Hospital; February 1947-August 1947, Clinical Assistant, Department of Medicine, Witwatersrand Univ. Johannesburg; September 1947-November 1947. Post graduate student., National Hospital, Queen's Square; December 1947-March 1948. Interne to Dr. Paul Wood, Hammersmith, Hospital, London; April 1948-November 1948. Registrar to Prof. J. McMichael, Hammersmith Hospital, London; December 1948-December 1949. Senior Medical Registrar, The National Heart Hospital, London. Previous Positions: January 1950-October 1954. Assistant Physician, (Tutorial) Johannesburg General Hospital and University of Witwatersrand, Johannesburg (Equivalent Canadian rank, Ass't Professor); October 1954-October 1955. Research Fellow, Harvard Medical School & Clinical and Research Fellow, Massachusetts General Hospital, Boston, Mass.; October 1955-September 1957. (1) Physician, (Tutorial) Johannesburg General Hospital and Univ. of Witwatersrand, Johannesburg, (equivalent, Canadian rank, Associate Prof.); (2) Head, Cardiac Service, Johannesburg General Hospital, Associate Director of the Cardio-Pulmonary Research Unit of the Dept. of Medicine and the Council for Scientific and Industrial Research; September 1957. Immigrated to Canada. Appointed Royal Victoria Hospital, Montreal Children's Hospital and McGill University. Military Service: 1942-1946: Captain, South Africa Medical Corps. Registra-

tion: (1) Registered as a medical specialist with the South African Medical and Dental Council, and the General Medical Council of Great Britain; (2) Certified in Cardiology, College of Physicians and Surgeons of the Province of Quebec. Present Positions: Professor of Medicine, McGill University; Physician, Royal Victoria Hospital; Dean, Faculty of Medicine, McGill University.

Moore, Dr. Keith L.: Born, October 5, 1925, Brantford, Ontario. Married: Marion Edith McDermid, 1949. Children: 4 girls and 1 boy. Education: (Elementary), Wallacetown Public School, Wallacetown, Ontario, 1932-38; (Secondary), Stratford Collegiate and Vocational Institute, Stratford, Ontario, 1938-44. Military Service: Royal Canadian Navy, 1944-46. Education: (Continued), B.A. General Science, University of Western Ontario, 1949; M.Sc. University of Western Ontario, 1951; Ph.D. University of Western Ontario, 1954. M.Sc. Thesis: The Morphology of the Nerve Cell Nucleus in Mammals. Ph.D. Thesis: Nuclear Morphology, According to Sex, in Human Tissues. Fellowships: National Cancer Institute of Canada Fellowship, 1953-54; Postdoctoral Fellowship, National Cancer Institute, 1954. Academic Appointments: Demonstrator in Anatomy, University of Western Ontario (1953-54); Lecturer in Microscopic Anatomy, University of Western Ontario (1954-56); Assistant Professor of Anatomy, University of Manitoba, (1956-59); Associate Professor of Anatomy, University of Manitoba, (1959-65); Professor of Anatomy, University of Manitoba, 1965; Head of the Department of Anatomy, University of Manitoba, 1965. Hospital Appointment: Consultant in Anatomy, Honorary Attending Staff, Children's Hospital Winnipeg, 1959. Other Appointments: Member of the Council, Canadian Association of Anatomists, 1959; Member of the Editorial Advisory Board of the International Journal, *Acta Cytologica*, 1960; Chairman, Medical Library Committee, University of Manitoba, 1964-1968; Member of the Board of Consultants, International Academy of Cytology, 1962; Member, Executive of the Association of the Academic Staff of the University of Manitoba, 1960-63, representing the Faculty of Medicine, University of Manitoba; Secretary, Canadian Association of Anatomists, 1962-65; Chairman, Medical Library Committee, 1963-68; President, Canadian Association of Anatomists, 1967-69; Chairman, Committee on Genetics, Growth and Development, 1965-69; Chairman, University Committee on Animal Care, 1967; Member of the Senate, University of Manitoba, 1966-69; Fellow of the International Academy of Cytology, 1968. Professional Associations: American Association for the Advancement of Science, 1951; Neuroanatomical Society (Cajal Club), 1952; Anatomical Society of Great Britain and Ireland, 1955; American Association of Anatomists, 1955; Canadian Association of Anatomists, 1956; International Academy of Cytology, 1962; Canadian Cytology Council, 1967. Research Bodies Supporting Research: National Cancer Institute of Canada, 1950-56; National Research Council, 1956-61; National Academy of Sciences (U.S.A.), 1957-60; National Health Grant, 1962-65; Medical Research Council, 1961. Present Research Projects: Congenital anomalies produced in the rat by podophyllin; Chromatin patterns in various rodents with special reference to sexual dimorphism in interphase nuclei; Self-disaggregation and self-reaggregation of embryonic tissues.

PUBLICATIONS:

1951—Moore, K. L., Graham, M. A. and Barr, M. L.: Nuclear morphology, according to sex, in nerve cells of several species and in various organs of the cat. *Anatomical Record*, 109 : 403.

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- 1962—Moore, K. L.: The genetics of sex determination and sex differentiation in man: Historical review and discussion of new ideas. *Manitoba Medical Review* 42 : 497-514.
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- 1964—Moore, K. L. and Dwornik, J. J.: Congenital defects produced in the rat by thalidomide. *Anatomical Record*, 148 : 313-314.
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- Dwornik, J. J. and Moore, K. L.: Skeletal malformations in the holtzman rat embryo following the administration of thalidomide. *Journal of Embryology and Experimental Morphology* 13 : 181-193.
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- Dwornik, J. J. and Moore, K. L.: Congenital anomalies produced in the rat by podophyllin. *Anatomical Record*, 157 : 237.
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- 1968—Moore, K. L.: The sexual identity of athletes. Editorial JAMA. 205 : 787-788.
- 1969—Daniels, E. and Moore, K. L.: A technic for studying self-disaggregation and self-reaggregation of embryonic tissues. Anatomical Record, 163 : 174.

Pearce, James William: Born in High River, Alberta in 1924; married Elizabeth Young in 1956 and they now have two children, Gwyneth Rowena, born in 1960 and Andrew David, born in 1962. Secondary education largely undergone in Eastern Canada; attended Queen's University, Kingston, and graduated M.D., C.M. in 1947. After a year as a general interne at Victoria Hospital, London, Ontario, continued training in physiology at the University of Oxford, receiving the D.Phil. degree in 1951. Subsequent appointments were as follows: 1951, House Physician, Hammersmith Hospital, London; 1952-53, Sessional Lecturer in Physiology, University of Western Ontario; 1953-55, Assistant Professor and N.R.C. Senior Research Fellow; 1955-56, Professor and Head, Physiology, University of Alberta; 1965-66, Visiting Scientist, during sabbatical year, at Institute of Animal Physiology, Babraham, Cambridge; 1966-67, Professor, University of Alberta; 1967-present, Professor of Physiology, University of Toronto. Extramural appointments of relevant nature have been: 1954-60, Member and then Chairman, Defence Research Board Panel on Aviation Medicine; 1961-65, Member, Canadian Heart Foundation Scientific Advisory Committee; Member, 1962-65, Medical Research Council Subcommittee on Anatomy, Physiology and Pharmacology; 1966-present, Associate Editor, Canadian Journal of Physiology and Pharmacology; 1967, Member of Medical Research Council Assessment Group for Physiology and Biophysics. Military and professional activities include: 1953-60, Medical Officer in R.C.A.F. Auxiliary Medical Units, retired W/C; Member of Physiological Society, American Physiological Society and Canadian Physiological Society, serving as President of the last mentioned for the year 1967-68. Author of scientific publications in several aspects of physiology, now actively engaged in teaching and research in this biological discipline.

Ritchie, Alexander Charles: Place and Date of Birth: Auckland, New Zealand, 2nd April, 1921. Education and Degrees: 1934-38, Hastings High School, Hastings, New Zealand; 1937, Matriculation; 1938, Higher Leaving Certificate; 1938, Isabella Siteman Scholarship; 1939-44, University of Otago, Dunedin, New Zealand; 1944, M.B., Ch.B. University of New Zealand; 1950, D.Phil. University of Oxford; 1955, Certified as a Specialist in Pathology by the Royal College of Physicians and Surgeons of Canada; 1956, Diplomate of the American Board of Pathology in Pathologic Anatomy; 1963, M.C.Path., F.C.A.P.; 1964, F.R.C.P.(C). Hospital and Academic Appointments: Jan. 1945-Dec. 1946, Auckland Hospitals, Auckland, New Zealand; Jan. 1945-May 1946, House Physician and Surgeon, rotating through Medicine, Surgery and Specialties; June 1946-Dec. 1946, Acting Neurosurgical Registrar; Sept. 1947-Mar. 1951, Sir William Dunn Schools of Pathology, Oxford; Sept. 1947-Dec. 1949, Member of the British Empire Cancer Campaign Research Unit, working on the mechanism of epidermal carcinogenesis in the mouse and the rabbit with Dr. I. Berenblum; Jan. 1950-Mar. 1951, Philip Walker Student of the University of Oxford, working with Sir Howard Florey on antibiotics; Dec. 1948-Mar. 1951,

Departmental Demonstrator in Pathology; Mar. 1951-Aug. 1952, Chicago Medical School; Mar. 1951-Aug. 1952, Visiting Fellow, Division of Oncology, working on the mechanism of experimental carcinogenesis with Dr. P. Shubik; Sept. 1952-Aug. 1954, Massachusetts General Hospital, Boston; Sept. 1952-Aug. 1954, Assistant Resident in Pathology; Sept. 1954-Dec. 1961, McGill University; Sept. 1954-Dec. 1954, Acting Director of Pathology, St. Mary's Hospital, Montreal; Sept. 1954-Dec. 1954, Sessional Lecturer in Pathology; Jan. 1955-Aug. 1955, Lecturer in Pathology; Sept. 1955-Feb. 1956, James Douglas Research Fellow; Sept. 1955-Feb. 1958, Assistant Professor of Pathology; Feb. 1958-Dec. 1961, Miranda Fraser Associate Professor of Comparative Pathology; Dec. 1961, University of Toronto; Dec. 15th, 1961, Professor and Head of the Department of Pathology; Jan. 1962, Toronto General Hospital; Jan. 1st, 1962, Head, Division of Pathology, Department of Laboratories. Others: April 1958, Member General Consultant Panel, Canadian Tumour Registry; April 1958-March, 1962, Consultant to the Canadian Tumour Registry on neoplasms of the male sex organs; June 1959-December 1961, Consultant in Pathology to the Department of Experimental Surgery, McGill University; March 1960-March 1966, Examiner in Pathology for the Examination for the Fellowship in Surgery of the Royal College of Surgeons of Canada; January 1st, 1962, Consultant, Department of Clinical Pathology, The Wellesley Hospital; March 14th, 1962, Consultant in Pathology, Hospital for Sick Children; March 16th, 1962, Consultant in Pathology, Ontario Department of Health; April 1962-January 1968, Consultant to the Canadian Tumour Registry on Tumours of Soft Tissues; November 1962, Member Negotiation Group, Section of Clinical Pathology, Ontario Medical Association; February 1963, Chairman, Committee on Residency Training, Canadian Association of Pathologists; February 1963, Member of the Programme Planning Committee, Academy of Medicine, Toronto; April 1963, Consultant in Pathology, Sunnybrook Hospital; June 1963, Member of Council, Section of Pathology, Ontario Medical Association; July 1963, Consultant in Pathology, Women's College Hospital; July 1964, Consultant in Pathology, Ontario Cancer Institute; 1964, Member, Pathology Committee, Royal College of Physicians and Surgeons of Canada; June 1956-June 1966, Vice-President, Canadian Association of Pathologists; October 1965, Member, Grants Panel, National Cancer Institute of Canada; October 1965-May 1967, Member, Clinical Advisory Committee, National Cancer Institute of Canada; December 1965, Representative for Canada on the International Board of Editors, Section V, General Pathology and Pathological Anatomy of the Excerpta Medica Foundation; March 1966, Member of the Committee on Credentials, Royal College of Physicians and Surgeons of Canada; April 1966, Examiner for the Fellowship in Pathology of the Royal College of Physicians and Surgeons of Canada; June 1966-June 1967, President-elect, Canadian Association of Pathologists; November 1966-November 1967, Member of the Committee on Examinations, Royal College of Physicians and Surgeons of Canada; December 1966, Member of the Advisory Council in Forensic Sciences, Province of Ontario; June 1967-July 1969, President, Canadian Association of Pathologists. Licence to Practice: 1944, New Zealand; 1947, United Kingdom; 1952-1954, Massachusetts; 1957-1961, Quebec; 1962-Ontario. Membership in Societies: 1945, British Medical Association; 1948 (resigned 1962), Royal Society of Medicine; 1952, American Association of Cancer Research; 1955, American Association of Pathologists and Bacteriologists; 1955, International Academy of Pathology; 1955, Quebec Association of

Pathologists; 1955, Pathological Society of Great Britain and Ireland; 1956 (resigned 1962), New York Academy of Science; 1957, Canadian Association of Pathologists; 1962, Ontario Medical Association, Section of Clinical Pathology; 1962, Ontario Association of Pathologists; 1962, Academy of Medicine, Toronto.

LIST OF PUBLICATIONS

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23. Tabah, Edward J., Gorecki, Z., Ritchie, A. C. and Skoryna, S., 1957. Effects of saturated solutions of tobacco tars and 9,10-dimethyl-1,2-benz-anthracene on the hamsters' cheek pouch. *Proc. Amer. Assn. Cancer Res.*, 2, 254 only, 1957 (abstract).
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26. Ritchie, A. C., Macklem, P. and Weigensberg, B. I., 1957. Atherosclerotic lesions in rabbits with haemorrhagic lipemia, *A.M.A. Arch. Path.*, 64, 556-562, 1957.
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56. Ritchie, A. C., 1967. The classification, morphology and behaviour of tumours. In: Florey, General Pathology, 4th edition, Lloyd Luke, London, (in press).
57. Marquis, Y., Wigle, E. D., Richardson, J. C. and Ritchie, A. C. Idiopathic medial aortopathy and arteriopathy. 44: 939-954, 1968.

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Taylor, Robert M. Born in Vancouver, B.C., September 9, 1913. Education: B.A., Biological and Medical Sciences, University of Toronto 1936, M.D., University of Toronto, 1939. Higher Professional Qualifications: F.R.C.P. (C) 1948, Certified Specialist in Internal Medicine 1948. Military Service: R.C.A.M.C., England and Northwest Europe 1941-5. Appointments: University of Toronto, Clinical Teacher, Department of Medicine 1948-50; 1955-66, Associate, 1966, Department of Medical Biophysics, Lecturer 1957-. Atomic Energy of Canada Limited: Director of Medical Services 1950-55. Canadian Cancer Society: Executive Director 1955-60, Executive Vice-President 1960-. National Cancer Institute of Canada: Executive Director 1955-. Princess Margaret Hospital: Consultant in radioisotopes, 1957-. Scientific and Pro-

Professional Societies: Member: Canadian Medical Association, Committee on Cancer 1960-, Royal College of Physicians and Surgeons of Canada, Ontario Medical Association, American Association for Cancer Research, Society of Nuclear Medicine, Canadian Society for Clinical Investigation. Government Agencies: Defence Research Board, Panel on Radiation Protection and Treatment, Member 1951-66, Chairman 1954-56, National Research Council, Advisory Committee on Clinical Use of Isotopes 1950-52, Associate Committee on Radiation biology 1960-67, Department of National Health and Welfare, Advisory Committee on Radiation Protection 1960-68, Advisory Committee on Smoking and Health 1962-. International Agencies: International Agency for Research on Cancer, Member of Scientific Council 1965-, International Union Against Cancer, Committee on Public Education, Chairman 1958-62, Commission on Cancer Control, Chairman 1962-66, Secretary-General 1966-.

Turcot, Dr. Jacques was born in the City of Quebec and is the son of the late Dr. René Turcot, a prominent Quebec otolaryngologist, and a grandson of Dr. Edwin Turcot, a former Dean of the Faculty of Medicine at Laval University. Dr. Turcot obtained a B.A. degree from Laval University and subsequently his M.D. degree from Laval University in 1940. He obtained his Fellowship in the Division of Surgery of The Royal College of Physicians and Surgeons of Canada by examination in 1943. Dr. Turcot is currently a Professor of Surgery at Laval University and a surgeon of the staff of Hôtel Dieu de Québec. Dr. Turcot has been a Member of the Council of the Royal College since 1962. He has participated very actively in many of the College affairs. He was Vice-President of the College from 1964 to 1966, and he has been President since January, 1968. Dr. Turcot's specialty is General Surgery.

Wightman, Dr. K. J. R. was born in Sandwich, England. He obtained his medical degree from the University of Toronto in 1937 and took his graduate training at the Toronto General Hospital and Cambridge University in England. Following the completion of his graduate training, Dr. Wightman served overseas with the Royal Canadian Army Medical Corps between 1942 and 1945. Returning to Toronto he joined the Faculty of Medicine of the University of Toronto and the staff of the Toronto General Hospital. Shortly thereafter, he became Professor of Therapeutics at the University of Toronto and subsequently succeeded the late Dr. Ray Farquharson as Sir John and Lady Eaton Professor and Head of the Department of Medicine at the University of Toronto and Physician-in-Chief at the Toronto General Hospital. Dr. Wightman is currently retiring from that post to become on July 1, 1969 Director of the Division of Postgraduate Education of the Faculty of Medicine of the University of Toronto. Dr. Wightman is a Fellow of the American College of Physicians and obtained his Fellowship in The Royal College of Physicians and Surgeons of Canada by examination in 1942. He has been a Member of the Council of the Royal College since 1964 and is currently also a Member of the Executive Committee of the Council.

Wigle, Dr. E. Douglas: Address: Cardiovascular Unit, Toronto General Hospital, 101 College Street, Toronto 2, Ontario. Present position: Director, Cardiovascular Unit, Toronto General Hospital. Associate Professor, Medicine, University of Toronto. Age: 40. Date of birth: October 30, 1928. Place of birth: Windsor, Ontario. Marital Status: Married—5 children. Schools: Dougall

Ave. Public School, Windsor, Ontario. Patterson Collegiate Institute, Windsor, Ontario. Faculty of Medicine, University of Toronto. Degrees: M.D. Toronto, 1953. F.R.C.P.(C), 1958. F.A.C.P., 1962. Undergraduate Awards: 1952—Third Year Medicine, Prize in Ophthalmology, Saddington Medal in Pathology; 1953—Fourth Year Medicine, Cody Gold Medal, Chappell Prize in Surgery, War Memorial Scholarship. Postgraduate Scholarships & Fellowships: 1955-56—British Council Scholarship. 1958-59—Ontario Heart Foundation Prize. 1959-60—McLaughlin Travelling Fellowship. Professional positions held since graduation: July 1, 1953-June 30, 1954, Junior Interne, Toronto General Hospital. July 1, 1954-June 30, 1955, Assist. Resident (Medicine), Shaughnessy Hospital, Vancouver, B.C. Aug. 1, 1955-June 15, 1956, Registrar (Pathology), Postgrad. Med. School, London, England. July 1, 1956-June 30, 1957, Assistant Resident (Medicine), Toronto General Hospital. July 1, 1957-June 30, 1958, Chief Resident (Medicine), Toronto General Hospital. July 1, 1958-Dec. 15, 1958, Fellow in Cardiology, Toronto General Hospital. Jan. 1, 1959-Aug. 15, 1959, Honorary Registrar, National Heart Hospital, London, England. Sept. 1, 1959-June 30, 1960, Research Fellow, Cardiovascular Research Institute, San Francisco, California. July 1, 1960-June 30, 1964, Clinical Teacher (Medicine), University of Toronto, Toronto General Hospital. July 1, 1964-June 30, 1966, Associate (Medicine) Director, Cardiovascular Unit, University of Toronto, Toronto General Hospital. July 1, 1966-June 30, 1968, Assistant Professor (Medicine), University of Toronto. July 1, 1968-, Associate Professor (Medicine), University of Toronto. Membership in Scientific Societies: Fellow, Royal College of Physicians & Surgeons of Canada. Fellow, American College of Physicians. Fellow, Council on Clinical Cardiology, American Heart Association. Councillor, Canadian Society for Clinical Investigation. Ontario (Canadian) Medical Association. Academy of Medicine, Toronto. Alpha Omega Alpha. American federation for Clinical Research. American Association for the Advancement of Science. New York Academy of Sciences. Clinical Research Society of Toronto. Canadian Cardiovascular Society. Administrative positions: Director, Cardiovascular Unit, Toronto General Hospital. Chairman, Period II Cardiovascular Curriculum Committee, University of Toronto. Chairman, Education Committee, Canadian Society for Clinical Investigation. Chairman, Sub-Committee on Research, University of Toronto. Chairman, (Internal Medicine) Medical Research Council Survey 1976. Department of Medicine Planning Committee, Toronto General Hospital.

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THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, June 4, 1969

The Special Committee on Science Policy met this day at 8 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have with us tonight eight very important groups. We will invite the chief spokesman for each group to sit at the head table, but everyone can participate in our seminar-type discussion period.

Would the following gentlemen please come forward: Dr. Jacques Turcot, President, the Royal College of Physicians and Surgeons; Dr. B. Cinader, President, Canadian Society for Immunology; Dr. Maurice LeClair, Vice President, L'Association des Facultés de Médecine du Canada, and Dr. D. Wigle, Councillor, Canadian Society for Clinical Investigation.

We will have short opening statements from the representatives of these four associations and then we will call on the other groups. I would like now to introduce Dr. Jacques Turcot, President of the Royal College of Physicians and Surgeons of Canada.

Dr. Jacques Turcot, President, The Royal College of Physicians and Surgeons of Canada: Mesdames et messieurs, ladies and gentlemen, the Royal College of Physicians and Surgeons of Canada is an organization that submitted a brief to this committee. This brief is divided into two parts, part one concerning the history and functions of the college and part two concerning the policies and activities of the college in relation to research and medical science. In the first part you will recall that the founding of the college took place in 1929 at the request of the Canadian Medical Association to set standards for specialty training in Canada. Through the years specialists have been trained under the guidelines and requirements set forth by the college. We feel that these requirements and

evaluation of specialists have been a great help in raising the standards of medical care and research in Canada. The college is concerned with establishment of standards, as I just said, and so to be able to set examinations, during the last few years the college has had to put forward a program of surveys in hospitals for graduate training and approving the programs in these teaching hospitals. At the completion of their studies and training in the approved programs, the candidates go through the process of examination set forth by the college.

The college is not only interested in the actual setting of standards and evaluating the qualities of candidates, but also in continuing education through the organization of scientific meetings on a national basis and also regional meetings.

Part two deals with the activities of the college pertaining to research and medical science. Our college is not directly involved in medical research as other bodies are, but it is very much interested in this field, because many of the trainees and candidates for the examination in many specialties have to be involved in research for their formation and training. This is more and more important and we can foresee in the future that the training programs will be directed by the faculties of medicine in universities and that the requirements for research for trainees will be more necessary and imperative.

The college has been favouring and supporting many bodies for their direct interest, such as clinical research and basic research. The college is also interested in providing standards and setting forth examination for those trainees and specialists working in laboratory medicine and to bring forward to all its membership news of what is going on in regard to its activities.

Two years ago the college established the "Annals of the Royal College of Physicians and Surgeons of Canada" which is another

means of providing all of these activities. Even more important, are the new activities in which the college has found it useful and necessary to move into, such as the implementation of automated techniques and administration procedures. By this, it will be able, in the not too distant future, to look into what is happening in graduate training with the help of the computer and all these data will probably serve to have the best conditions for graduate training.

Finally, one of the most important functions in the last few years has been the creation of the McLaughlin Centre. The R.S. McLaughlin Examination and Research Centre is looking into all matters of examination, and establishing research in the evaluation processes in the medical field, in medical training, and so on.

Other organizations are already using the centre with great success. We can foresee that the McLaughlin Centre in a very short time will become one of the main aspects of activities of the Royal College. The centre has already produced some very interesting research into the evaluation techniques and how to assess the trainees in residences, and indirectly the value of the programs.

So the College, to achieve all this, has to work in close co-operation with many other societies and associations. One of the most important probably is the Association of Canadian Medical Colleges, because the universities are now conducting and directing the training programs and the Royal College is assessing, with their co-operation, through examination, the qualifications of the candidates.

The College is also involved in close liaison with the provincial colleges, including the Collège des médecins et chirurgiens de la province de Québec, to try to establish either joint examinations with the Quebec college or some very close liaison.

This is a very brief aspect of how the College is interested indirectly in basic research with the co-operation of the medical schools, because the trainees have to go—most of them, or many of them—into this field, and a bit more directly into research in the evaluation techniques with the R.S. McLaughlin Centre and with the collection of data on the files of all candidates, from which some interesting conclusions in the future may be drawn.

The Chairman: Merci beaucoup, Dr. Turcot. We have also tonight, I understand, Dr. Ian

Rusted and Dr. Charles Drake, both of whom are vice-presidents of the College; and Dr. James H. Graham, who is the secretary of that association. I hope they will be able at a further stage to participate in our discussion.

Dr. Turcot: May I add that we have with us the past president Dr. R. B. Kerr; and also an executive member, Dr. K. J. R. Wightman.

The Chairman: We will hear now from Dr. B. Cinader, President of the Canadian Society for Immunology.

Dr. B. Cinader, President, Canadian Society for Immunology: Mr. Chairman and honourable senators, I am overawed by the company in which I have been invited to present our point of view. I find that we are surrounded by the tradition of centuries, while our society is but two years old.

It may be that this is a justification for you to listen to us, because what we have specifically to say is the story of a group and of a problem that we will encounter again and again in the future, because immunology is becoming one of the growing points of modern medicine. This is where the evolution of surgery is to lie and where in the years to come the most important advances in medicine will be made.

I should not repeat the brief, which is in your hands, but I will state two variables in the development of this new movement in medical research—the grant giving body on the one hand and the university on the other. These may well be a prototype of development that is to go further and will continue over the years.

As to the grant giving body, basically we are in agreement with everything stated by other learned societies about the granting structure they want to see.

The Chairman: They have not all said the same thing.

Dr. Cinader: They want to see the original initiative lie with the research worker, who sees a plan and goes to the granting agency. There he is evaluated by his peers and then receives research support. We feel that this should continue, and continue at a higher level of funding. Thus this support of peripheral initiative should remain the main format. However, it is not a sufficient format. In

addition to this, we require much greater emphasis on a second form of granting, which is already in existence with both the MRC and the NCI which we would describe as "group" support. This is an association organized by one man. It constitutes a group of capable investigators, all with a common philosophy of approach, and supported by continuing guaranteed financing. They are an informal department, they are not an institution which survives beyond their utility; they are mortal; the group dies with the senior investigator. This exists, but it needs to become a much more common form of research organization, and much greater financial support for this type of operation should be made available to the MRC.

Perhaps I may say, quite briefly, how I see the university, in order to strengthen the point that the "group" is required. The university, as we have it now, is still strongly influenced by its foundation in the thirteenth century. It was founded to preserve what knowledge was left from the Roman Empire. The early scientists worked outside this framework.

As time went on, the backroom of the rectory in Manchester and the rooms in the breweries of Copenhagen were no longer sufficient. The university became the home of research, but the organizational structure of the university remained unchanged. This format was taken holus bolus across the Atlantic. Here a new and third function was added to the task, the function to help young people lead a "full life". This was reasonable and was a wonderful aspiration but quite distinct from the two other aspirations—training in crafts and research—for which the university was already responsible. These three roles are often contradictory. It is partly responsible for the student unrest which we see in Europe and in the United States, but which has not hit us yet. In short then the university has been burdened by social pressure to fill three roles—the craft role, the research role and the "how can you live a full life" role. One institution cannot be true to all these ideals. We need at least some institutions which specialize in one of each of these three roles. We have more time than others to solve this problem because the conflict has not come here yet and because we are still setting up new schools of higher learning.

In the meantime the university operation cannot be rapidly responsive to new chal-

lenges. The needed flexibility in this area can be obtained by the "group structure" of support which we have advocated as the ideal way to promote new departures on an adequate scale.

The Chairman: You gave me a very good transition, because we will hear now from the Association of Canadian Medical Colleges, and most specifically from Dr. Maurice Leclair, Vice-President. I understand that when he tries to earn a living he is the dean of the most flexible medical faculty in Canada.

[Translation]

Dr. Maurice LeClair, Vice-president of the Association of Canadian Medical Colleges: Mr. Chairman, honourable senators, allow me, on behalf of the Canadian Medical Association, to take this opportunity to thank you for inviting us. It is obvious that the agenda for this evening is very full. . .

[Text]

If you will permit us, our brief will be brief. I do not intend to read all of it. You may allow me to stress one important point. It is the psychological advantage, because the brief is mostly concerned with the Medical Research Council, though prepared by the ACMC; so we cannot be accused of talking too much about our own organization. We have left that for one of the other organizations.

The ACMC is mostly concerned with the importance of medical research in medical education. I think we mentioned this when the Medical Research Council was here a few months ago. Without medical research, most medical schools would not be able to function and fulfil their roles as educators. So what happens to MRC is vitally important to medical schools, and much more so to deans.

In these days of regionalization in education and research, perhaps a point might be made for research becoming a regional affair. The ACMC strongly supports medical research at all times on a national basis. The main reason, of course, is that there is a much better chance of good peer judgment, if it is done on a national basis, and also it is less likely to have regional disparities, if the research endeavour is on a national basis.

The first recommendation is that, since in our opinion a federal agency such as the Medical Research Council as presently con-

stituted is a uniquely effective mechanism for the stimulation and growth of medical science in Canada, it is recommended that no change in federal policy should be made which would weaken or interfere with its function.

Our second recommendation comes from a concern with what has happened so far to health resources funding. There has been, growing from the Royal Commission on Health Services, money made available to develop health resources in Canada, but the increments in funding to the Medical Research Council have fluctuated over the years, and it has become increasingly difficult for medical schools to do any sort of long-range planning in medical research.

The importance of medical schools from now on in what is called operational research or research in the delivery of medical care is becoming something which I think most medical centres will dwell on more and more from now on. Our own schools, and many new schools, have started programs in research on the delivery of medical care, and, probably within the next decade, this is where many of the breakthroughs will be seen. For this reason our second recommendation is that a substantial expansion of federal financial support to medical science is required to keep pace with the growth of health science education, stimulated by the health resources fund in response to needs identified by the Royal Commission on Health Services. Predictable long-range policy on financial support is necessary to permit rational planning and to develop the most advantageous balance in the committee of available resources to fundamental applied operational and developmental research.

Our third recommendation, I am sure, is a controversial one. It concerns the cost of overhead expenses to universities to permit medical research.

The Chairman: Perhaps controversial, but not new.

Dr. LeClair: As you will find, this is the shortest part of our short brief. The only thing we say here is to perhaps point to a comparison with what is happening in the United States, where a sum varying from 15 cents to 50 cents for every dollar is given to universities to defray the overhead costs.

Finally, the last part of our brief concerns the very survival of ACMC as an institution. This was first developed from the various

medical schools as a need to have a national body concerned with medical education across the country. It has fulfilled its role and is now embarking on other important functions. These include, for example, projections of needs for health manpower, cost studies of the operation of medical schools and teaching hospitals, a data bank of medical school applicants and an accreditation of medical schools and the problems of making sure that physicians from Vancouver to St. John's are of the same calibre. Only a national body can ensure this.

However, ACMC, like many other associations, has difficulty with its funding. So far it has had some of its funds from the medical schools and some of its funds from grants in aid from American foundations, and it is now concerned with its very survival. Unless the federal Government intends to set up an alternate method of collecting and collating information of the type now handled by the Association of Canadian Medical Colleges, the national role of this association should be recognized by solid long-term federal funding.

[Translation]

Mr. Chairman, it is a question, I believe, of the survival of the Canadian Medical Association, which plays a very important role, and will continue to do so in the decade to come.

The Chairman: Thank you very much, Dr. LeClair.

[Text]

As most of you probably know, Dr. LeClair has already appeared before us in another capacity, with his "boss" who is in the room here, Dr. Brown, the representative of the Medical Research Council. So he is wearing another hat tonight.

We will now hear from Dr. Wigle who represents tonight the Canadian Society for Clinical Investigation.

Dr. D. Wigle, Councillor, Canadian Society for Clinical Investigation: Mr. Chairman, honourable senators, the Canadian Society for Clinical Investigation welcomes this opportunity of appearing before your committee. We shall assume that the contents of the brief are familiar to you and we shall concentrate now on several main points of concern. The first is that our society believes that the time has now come to set aside the arbitrary distinctions between the different kinds of health research and to look upon health research as

a continuum. This broad continuum that constitutes health research today is represented in our membership whose interests range from fundamental or pure research, through clinical and applied research, to operational research, into the delivery of health care to the community. Hard and fast distinctions between these types of research have little current relevance, for they are all required, if the ultimate goal of health research is to be achieved, that is, the improved health care of the community.

Secondly, we would like to speak briefly on the role of researchers in health care delivery and education. Investigators not only seek new knowledge in their research, but they are in a position to apply new knowledge discovered elsewhere in Canada and in other countries. Thus, while regionalization of health care and the extension of health insurance programs will permit a greater quantity of medical care to be delivered to Canadians, researchers working in teaching hospitals are in a position to offer a quality of health care that our countrymen deserve and demand.

Medical researchers have important roles to play in medical education, one of which is to instill in the student the investigator's inquiring state of mind in order that he can partake in full in the life-long learning process that is medicine today.

The third point we should like to comment on is the research environment and the current financial stringency. Prior to the year 1965-66, medical research in Canada was supported at distressingly low levels. Between 1965-66 and 1968-69 the total amount available for support of research almost doubled. This increase in operating funds, together with the initiation of the Health Resources Fund, as well as belated responses to previous inadequacies, gave promise that there would be satisfactory conditions for the expansion that is in prospect for the decade ahead, arising from the growth of the 12 existing medical schools and the formation of four new ones.

This major expansion in available financial resources seemed only appropriate to the increasing per capita demand for health services and Government demands that more medical and health personnel be trained.

It was in this context of an improved environment that the news was received of a ceiling in annual disbursements from the Health

Resources Fund and a slackening in growth rate in Medical Research Council funds to less than half what it had been before. Although these changes result from the current financial stringency, they could hardly have occurred at a worse time in relation to the long-term program for expansion of the health education and health care base in Canada.

This society expresses deep concern that the percentage of successful research applications to the Medical Research Council for the current year is at the lowest level since the Council's inception. This has occurred in spite of an increase in the quality of the applications. Equal concern is expressed at the notion that it is realistic to set a fixed rate for release of Health Resources Fund monies at a time when the rate of expansion of medical schools and the health care base is accelerating. This program of medical school expansion and the improved research environment has been a long time in coming and is extremely susceptible to turns of the financial tap and start-stop financing.

The last few years have seen the establishment of a basis for sound development in medical research in Canada. Recent events have set this back considerably.

In addition to these problems arising from current financial stringency, there are very great problems arising from the lack of co-ordination and planning between the two levels of government and agencies and institutions, all of whose co-operation is required to achieve health goals in an effective way.

It is as a result of these considerations, Mr. Chairman, that we have made certain recommendations in our brief which may be summarized as follows; first, we would like to see that all levels of government in Canada recognize that the health of the nation is of the highest priority. It is recommended that the federal government adopt and announce a long-term financial policy for health research and for the upgrading of health training facilities that will avoid the harmful effects of start-stop financing.

It is recommended that the federal government restore the rate of growth in funds for the Medical Research Council to that of prior years.

It is recommended that the federal government make available capital funds in accord with the needs of areas and institutions, rath-

er than on the basis of a fixed annual amount, which is unrealistic in a long-term program of expansion.

It is recommended that provincial governments greatly increase their provisions for health research, particularly in establishing new investigators and in fields not being covered by other granting agencies, such as research into the delivery of health care.

The Chairman: You do not expect us to make any recommendations about that?

Dr. Wigle: No, but this will come to light in further comments we may make.

We further recommend that the federal and provincial governments together make provision for health training and research in a manner appropriate to the magnitude of health activities in Canada, and increase their provision of funds for research into the broader aspects of health care delivery. We further recommend that they make special arrangements to overcome deficiencies in health research in particular fields and centres, and to provide for the needs of new institutions.

Finally, it is recommended that all those engaged in the field of health, governments, agencies, institutions and professions, recognize that consultation, co-operation and co-ordination are essential for achieving health goals in an effective way.

This society is sufficiently concerned about the problems outlined in its brief that it has gone to considerable trouble and expense to have 4,000 French and English copies printed in booklet form. It is our intention and hope to make the contents known to the provincial governments and interested citizens as well as to members of the federal government in order that the current problems in the health field may be more widely appreciated.

Thank you.

The Chairman: Thank you very much.

I suppose some members of the committee may become a little frustrated but we will have to proceed to the second shift. I hope you will remain available for questioning.

Now we will have Dr. Pearce, President of the Canadian Physiological Society, Dr. Copp, President of the National Cancer Institute, Dr. Keith L. Moore, President of the Canadian Association of Anatomists and finally Dr. Ritchie, President of the Canadian Association of Pathologists. Again we will have a series of brief statements and eventually we

hope to reach the question period. Now I will call on Dr. Pearce.

Dr. J. W. Pearce, President, Canadian Physiological Society: Mr. Chairman, honourable senators, ladies and gentlemen, this brief was prepared on behalf of the members of the Canadian Physiological Society, which is largely made up of academic physiologists. I said at the time of preparing the brief that many of the more material problems of carrying out physiological research had been very well surveyed by the visiting teams that eventually produced MRC Report number 2, and that perhaps it would be worthwhile to use this occasion to stress some of the more private problems of practicing scientists in Canadian universities. Therefore this is really the basis and purpose of this brief.

I stress at the beginning that one of the major problems of carrying out scientific research of high quality, as I think most academicians will agree if they are being quite honest with themselves, is to compete for the necessary time to carry out the quality work which is needed. I have underlined in the brief the various commitments which every academician must take on, and at the same time emphasized that to do quality scientific research requires not only what is known as bench participation but also a good deal of serious and critical reading of the literature and attendance at scientific meetings which is a necessary part of the communications aspect of carrying out scientific work.

I felt that it would be worthwhile in any science policy formulation to consider this aspect which governs the effectiveness of the research which is being done in universities. I did not at all want to undermine the importance of what can be done by universities, but I did want to emphasize that certain provisions might well be taken into consideration in future science policy formulation which could provide a better environment in universities for undertaking quality research. I suggest that one possible direction of academic evolution might be the division of traditional university science departments into sub-departments, one of which would be primarily concerned with undergraduate teaching, and the second of which would be primarily concerned with graduate teaching and research. This, of course, is not a primary concern, I understand, of the enquiry

by such a committee as this, but it is a suggestion of the type of direction or evolution which might possibly be added by the type of grant policy which develops particularly with regard to the support of personnel.

This type of streaming, if you like, of the university scientific department activity would certainly be aided by the creation of more full-time research positions subsidized with funds which were supplementary to the ordinary university budget. It would also be aided by the creation of more research units which are, of course, well known in Britain and which are accepted as a policy by the Medical Research Council, for instance, but which are very few in number at the present time.

While describing such units I have drawn attention to some of the dangers of making the purpose of such units too pragmatic. This is a long and debatable issue which has been discussed by many people before, but I think the university is the place for basic research to be done. I think everyone will agree that fundamental research is, as other speakers have already mentioned, essential to the eventual progress of applied research, and the universities are probably the best place in which to maintain this particular facet of scientific activity. So I would hope that more such units would not necessarily have to be mission-oriented, but could, in fact, also be devoted to certain fundamental problems which will indeed have some practical application ultimately.

Then, moving on to the second area of consideration, I suggested that there is perhaps a requirement for an increasing independence of Canadian scientists in the field of scientific documentation. This aim could be assisted by subsidization of publication of reviews, symposium reports, monographs and textbooks to be prepared by workers in this country. I suggest it is one means, again, of ensuring that the practising scientists is obliged to take time to do scholarly reviews, and I have also proposed short-term leave periods might be sponsored through appropriate agencies to allow and encourage the preparation of scholarly works. This seems a rather trivial issue, perhaps, but it could be an important and not too expensive policy, to ensure that academicians do have time for what is described by Osler as "periodic brain dusting," which so few of us have the opportunity to undertake.

The Chairman: I thought we had all the dust in the Senate!

Dr. Pearce: In considering the role of Government, it is suggested that new support programs be designed to ensure the growth of effective research environments in universities, without depriving the scientist of independence of initiative.

I have also drawn attention to the possibility that such programs, if not wisely designed, could undermine the parallel development of the teaching functions of the university which are, of course, becoming a greater and greater part of their activity. So that close consultation with appropriate academic representatives, such as, in particular, faculties of graduate studies in the universities, as well as operation through experienced funding bodies, such as the Medical Research Council, would help to avoid undesirable consequences of new forms of support which might lead to redirection of university effort.

I mentioned also the predicted saturation of the academic market for Ph.D. graduates in the field of physiology. This subject has been dealt with in earlier presentations to this committee, I think—the danger that by, perhaps, 1975 there will not be available sufficient academic posts to provide positions for the graduates we are now in the process of training. This situation is aggravated by importing from the United Kingdom and the United States new young staff members at this particular time, when the increased graduate student body has not yet perhaps reached the peak of numbers that will result when graduation occurs. Certainly, the prediction in the MRC Report No. 2 for Physiology is that by 1973 there will be a saturation of the academic market place.

The Chairman: I am sure, doctor, some of these things will come back into the discussion, so I wish you would more or less go over them a little quicker, because it is already a quarter to 9 and we certainly also have questions to ask you.

Dr. Pearce: Yes, I am just about concluded.

The Chairman: I do not want to limit you in any way, but...

Dr. Pearce: I think actually this was really the final point. I again emphasize the importance of ensuring the participation of faculties of graduate studies in science policy formulation, because I think these are the logical bodies in universities to be aware of the poli-

cy changes which may be considered and to contribute to them.

I think that probably concludes the essence of the brief, Mr. Chairman.

The Chairman: We will come back to you again later.

Now Dr. D. H. Copp, who is President of the National Cancer Institute.

Dr. D. H. Copp, President, National Cancer Institute: Monsieur le président, honourable senators and ladies and gentlemen, I would like to express the appreciation of the Institute for this opportunity to present our brief in person, and also to congratulate the committee on this very important job of surveying current thinking on science policy. I hope this is something which will continue.

While I will be speaking for the National Cancer Institute, many of my remarks will apply to other voluntary agencies which support medical research, such as the Canadian Heart Foundation and the Canadian Arthritis and Rheumatism Society. Dr. Brown, in his presentation to this committee, stressed the value of having such alternative sources of research support.

I think there is another very important role which the voluntary agencies play, because they have involved the Canadian public very deeply in the health effort and the research effort. At the present time over 800,000 Canadians have contributed to the National Cancer Institute in the past year, and this has provided what is the second largest organization for the support of medical research. This, I think, is an expression not only of deep public concern for this particular illness, but also for health in general.

Over the past 20 years since the Institute was founded, cancer research in Canada has developed from almost nothing to a place where it is respected throughout Canada and the world. It has also been possible to pioneer many new developments. For example, the first group research projects, the first career awards and the first actual units built were paid for by the people through voluntary contributions.

The Chairman: Excuse me, but I was smiling because I was wondering if I could smoke in your presence!

Dr. Copp: I was so carried away that I did not notice it. That brings me to another point, because the institute has also been a major adviser to the Government on the question of

cancer, including smoking I may add. It is too late now to do anything about it. One of our problems has really been the success of the Canadian Cancer Society and the Institute, because voluntary support now provides about 90 per cent of the cost of our program; 10 per cent is derived from Government sources, but the capacity for the public to contribute more is limited, as you know. The Cancer Society expects an increase of 10 per cent per annum, but this is not enough to pay for the increase in costs of our program and there is no opportunity to take advantage of the new medical schools which have been created. We have applications from McMaster, Sherbrooke and Queen's for the establishment of cancer units. With our limited resources there really is very little that we can do about it. We feel that the private agencies and the volunteers should be encouraged to continue their support. It makes them interested in the cause of health and it also saves the Government money spent on the current program. On the other hand, if this is to grow, the voluntary agencies should have some of the potential which the Medical Research Council, quite properly, has. To take an example, at the moment the National Cancer Institute receives in the United States almost a dollar per capita from the federal Government; in Canada, I am sorry to say, we receive less than two cents per capita. It is very difficult to correlate this need with the amount of money which is available.

In our brief we have suggested a formula which might not only continue to give the public interest in contributing, but also increase the Government's share in this. Our suggestion is that the amount of money which is contributed by the Canadian Cancer Society, for example, and used for research should be matched percentagewise by the Government contribution, rather than remaining at the present fixed level. Eventually I would like to see this at a matching basis, but since all things have to start slowly our suggestion is that it might start at 20 per cent and increase after you reach a stage where a person contributed a dollar that this was going to be matched by the Government. The contributors would then feel that their concern with cancer was going to be matched by the Government's concern.

The Chairman: Next we will hear from Dr. Keith Moore, President of the Canadian Association of Anatomists.

Dr. Keith L. Moore, President, Canadian Association of Anatomists: Mr. Chairman, honourable senators and fellow scientists: First of all I would like to thank you for the privilege of presenting a brief and for the extra privilege of being here to see how the committee operates. I am quite impressed. When we considered submitting a brief we wondered whether this was necessary, because there was a good report on anatomy which appeared in the Canadian Medical Survey and Outlook prepared by the MRC in September 1968. This covers very adequately the needs of anatomy and I would refer anyone to that for more detail. We also felt that we could probably be briefer than that and emphasize those points which seemed to be bothering us. The anatomists as a group are not very big; it was formed 13 years ago with 65 members. It now represents 237. These are all professionally qualified people, mostly in the anatomy departments in medical, dental and veterinary medical schools, but there are a number of anatomists in zoology and biology departments of the universities and research institutes.

With the increase in demands for health services comes an increase in need for health scientists. All professional persons in health sciences require a knowledge of the structure and function of the human body. To teach them one must train more teacher-scientists; I emphasize this dual word, teacher-scientist, because we feel this is a necessary thing. To train these people we need more facilities, funds for student support, personnel support and more funds for research, equipment and operating expenses. These are not new; these are difficulties we share with many people. At present all these needs could be met by more money.

Although much is made of the so-called reverse brain drain, it is not occurring to any great extent in our discipline because the rapid expansion of the medical and paramedical schools in the United States is using up all available anatomists. Although support for anatomists is not as good in the United States as it used to be, it is still better than it is in Canada. The result is that some of our scientists, the young ones particularly, are going to the United States for more lucrative jobs where they can get support for their research.

In our brief we say that the Association of Canadian Medical Colleges receives a grant from the Department of Manpower and

Immigration to keep a record of graduates of Canadian medical schools working in the United States and to attempt to attract them back home. I think this is a wonderful thing, but we also feel that it would be better to improve research and teaching conditions in Canada so that they will not leave in the first place. Not only do our scientists leave to work and study in the United States because the funds are more often readily available through training grants; once they are trained they are not likely to return to Canada to universities where the research facilities are inadequate and the grant support is less. This hits anatomists more than others because, as I said at the beginning, all health scientists require a knowledge of the human body, its structure and functions. Thus our departments have been crowded with dental students, veterinary and biology students and nurses, so that what was planned for medical students is now being used to train these many paramedical groups and research space has suffered.

Although federal funds have been allocated for improvement of these health sciences facilities in general, we see very few results. I keep looking across at the department of Ottawa University where they tell me a new building will be some day, but I do not see any asphalt being turned up. As a result of this crowding the funds are just inadequate for the training of the many new scientists that we need.

We are not in a position where we can say that there will be too many anatomists in ten years; we see a very great shortage, so we feel that we need additional funds to train these people, but along with this we need more funds for space in our universities and research. Give our universities adequate funds to provide the facilities; give the Medical Research Council adequate funds to meet the modest requests of our scientists for research and the support of our students, and we will train all the anatomical scientists that will be needed to train the great number of health scientists needed to meet the people's demands for health care.

Thank you.

The Chairman: Finally, we have Dr. Ritchie from the Canadian Association of Pathologists of Ontario Universities.

Dr. A. C. Ritchie, President, Canadian Association of Pathologists: Mr. Chairman,

honourable senators: Perhaps I should say that, though this brief is endorsed by the Canadian Association of Pathologists, I am presenting it tonight, and must thank you for the opportunity of doing so, on behalf of a body which has the cumbersome name of the Association of Chairmen of Canadian University Departments of Pathology. I think I have included all the words. The only reason why Ontario has got into the name is that the brief was written by the chairmen of the universities in Ontario, largely because it was easy for us to meet and to discuss what we should say. It is, however, referable to the whole of Canada, even though it makes several observations about Ontario in particular. I think perhaps the only remark I might make further to that is that so far as pathology is concerned, and indeed certain other aspects relevant to this committee, Ontario is not the least well endowed part of this country.

I should say, too, that in speaking of pathology we have taken a very catholic view of the meaning of that word. We have taken it to include all branches of laboratory medicine and anatomical pathology, haematology, chemistry, microbiology, the whole lot, as well as experimental pathology, and as well as all the teaching associated with this. I mention this particularly because the organization of pathology in universities differs very greatly and there is no uniformity at all. In some universities this total area is in one department; in many it is divided amongst several different departments.

You have the brief and it would be foolish of me to go through it in any detail or discuss it at any length. Instead, let me merely emphasize a few of the points which seem to my colleagues to be of particular relevance.

First, as with many other departments, particularly in the clinical area, departments of pathology have three main tasks: a clinical service to patients, teaching and research. We would like to emphasize very strongly that in our opinion you cannot separate these three functions by any sensible or truthful means. Many of our activities subserve all three purposes to a varying extent, and to maintain a healthy department in any one of these aspects we must maintain health in all three. Therefore, I think in considering the needs of pathology from the scientific point of view you must consider the whole department; you cannot in our opinion have a department

scientifically sound unless it is also clinically sound, and unless it is both of these things you cannot have a department that will teach well for very long.

Secondly, we would like to emphasize that the work of departments of pathology has grown very greatly in recent years, partly because of the very large development in medical technology in general, both for research work and clinical work, and partly because of the need to develop sub-specialties in pathology, that I will come to later. I am sorry to say that in view of this increased demand, and in view of this increased need, pathology has not kept pace with the requirement. As has been pointed out in, for example, the Hall Report or the MRC surveys recently completed, it has fallen considerably behind either the national need or parity with other branches of medicine.

One of the principal weaknesses in pathology that we would like to stress, with the various points we make in our brief, is the need to develop what we have called sub-specialties. By this I mean that to a very large degree both our work and research in medicine is carried out by teams of people interested in some specific area, such as, for example, a neurological group interested in neurological diseases, or a group interested in liver diseases, or a group interested in say, transplantation. I could expand the examples almost *ad nauseam*.

To be successful these groups have to run across the ordinary divisions of medical practice; they must be inter-disciplinary. One considerable need is that they should have in them an appropriate pathological representation. This has not been yet, I think, satisfactory anywhere in the country. It has been attempted to varying degrees, and the principal limitation on our development in this area is lack of men, lack of space, lack of facilities. I think this is perhaps one of the major points of our submission.

Granted that we could develop this kind of sub-specialization, then I think we proceed with confidence into the task of teaching. We have many types of teaching—undergraduate teaching, the training of specialists in pathology, assisting in other specialties, the training of graduate students in research work, continuing the education of people already in practice, training of para-medical, technical people, and so on, a great many types.

The particular element in relation to that that I think is relevant this evening is the training of specialists in pathology who will be able to subserve the needs of the combined clinical teaching and research department. This type of person must be not only competent as a practising pathologist to a reasonable degree on the clinical side; he must be trained also in research work as well; he must be, if you like, the teacher-scientist-clinician—any hyphenated name. Within the department we must be able to strengthen all these three people. This, I think, is our principal challenge now, to train this kind of man, this kind of pathologist, for university and for community needs.

Perhaps those are the only points I need stress now, Mr. Chairman. I am sorry that our brief has necessarily had to remain in rather general terms. We could delineate the problems as we saw them. We could not offer you any very concrete solutions to them, and this is a matter that I think will require some study by us and by many people before a concrete proposal can be brought forward sensibly.

The Chairman: Thank you very much. We will now leave you in the hands of one of your peers for a few minutes, and afterwards the patients will have their moments of truth.

Senator Sullivan: I think the theme of most groups who have presented briefs before this Committee has been from the song "Call Me Madam"—"Money, Money, Money." If that was ever indicated, I would say it is more in medical research than any other group we have had before us. That is a pretty good plug for the doctors!

Dr. Turcot, in the brief from the Royal College you make this suggestion on page 2:

Provision for wide consultation by Government on scientific policy is recommended. The Royal College would be anxious to have representation on any consultative body established.

I would say that this is a legitimate request. You mean irrespective of the Medical Research Council?

Dr. Turcot: We feel that the Royal College is involved in medical education on a wide-nation basis so it should be aware of matters that pertain to this field, including research, education and so on. Is this the point of the question?

The Chairman: Do you have members of your council as members of the Medical Research Council?

Dr. Turcot: Yes.

Senator Sullivan: Dr. LeClair.

The Chairman: I know.

Dr. Turcot: Members of the Royal College are also members of all associations in Canada and vice versa.

Senator Carter: You have been infiltrated.

Dr. Turcot: We have been infiltrated.

Senator Sullivan: On page 5:

The Royal College is thus in a position...

The Chairman: I am sorry, Senator Sullivan, but at this stage I think that all those who want to comment on answers should be allowed to participate if they want.

Senator Sullivan: Thank you. On page 5:

The Royal College is thus in a position to act in an intermediary capacity concerning the academic and the practical aspects of specialty qualification and practice in Canada.

I wonder if one of our groups would enlarge on that just a little bit.

Dr. K. J. R. Wightman, Executive Member, The Royal College of Physicians and Surgeons of Canada: I think the point is that the college, having responsibility for training programs or taking responsibility for trying to supervise and upgrade training programs for specialists and clue them in.

In those training programs some activities which are research oriented, are perhaps trying to make sure that training includes research and that the results of research are incorporated into practice as rapidly as possible and that new knowledge about medicine is disseminated through the profession, not only the specialists' profession, but the whole profession. I think that is what that means.

Senator Sullivan: Thank you. Does anyone else wish to ask a question?

Dr. Turcot: On this question, Senator Sullivan, it might be emphasized also that the Royal College, having liaison with the schools, on the one hand and the national societies on the other hand and the provincial colleges, is in a position to have the views of many associations and bodies.

Senator Belisle: Many times we have requests from, I would say, new Canadians, who are coming from abroad and asking a politician to assist him in order to get into see you people, because they claim that you have a closed corporation. Is this so? Do you have a closed corporation in the sense that you do not recognize what they already have unless they do the training either in Ontario, Quebec or Manitoba? Are you becoming more sympathetic to them or are you gradually closing the door even more?

Senator Sullivan: Sympathetic to their qualifications, not closing the door.

Dr. Charles Drake, Vice President, The Royal College of Physicians and Surgeons of Canada: We are sympathetic. The door is wide open providing we have sure knowledge of their background and training and commensurate to what we consider to be a minimum standard for the practice of medicine on the Canadian public.

The Chairman: In any case, Senator Belisle, I am sure you know that even if the door were closed and even if we wanted to open it we could not here, because this is a provincial responsibility.

Senator Sullivan: I think what probably prompted Senator Belisle's question was the handling in Ontario of the dentists from Czechoslovakia. I am referring to page 6, part 2:

Since many trainees are interested primarily in the practical clinical application of their specialty and are not necessarily suited to research training, such training is not mandatory under Royal College regulations.

I wonder if a group would enlarge on that for the benefit of the committee.

Dr. Wightman: Well, sir, we have about a quarter of the training program which can be carried out in a research laboratory, but we do not insist that all of our trainees go through this, partly because proper experience in research probably requires at least two years of activity in the research laboratory. Some of the trainees are better employed by having all of their time devoted to training in the hospital and working with patients and being exposed to the research work that is going on in the teaching hospitals and institutions and the sort of inquiring atmosphere that is produced but not actually taking part in research themselves as part of their training. We do not feel this is essential. Certain

trainees do this and profit by it, but not all of them. We do not insist upon it because it does not seem sensible to do so. We do like the people to have their training in a place where research is going on so that they are aware of the advances in the field and the methods whereby scientific advances are made and the whole inquiry atmosphere where old information is reviewed and sometimes discarded.

Senator Sullivan: Mr. Chairman, I think a very significant point in the brief of the college is on page 8 and page 9. It says:

The most important Royal College function is the conduct of its examinations. Research in testing and examining techniques in recent years has emphasized the development of objective methods of examining...

I wonder, Dr. Drake, if you might speak to that and compare the standard of the Royal College of Physicians and Surgeons of Canada, say, to a comparable situation in the United States?

Dr. Robert B. Kerr, Immediate past President, the Royal College of Physicians and Surgeons of Canada: During the past three years there has developed this new approach to examination within the Royal College and this is based upon a research program which is being developed under the leadership of Professor Donald Wilson, University of Alberta and with the very generous support from the R. Samuel McLaughlin Foundation. I think this represents a very interesting and very useful contribution from private sources to funds to the development of this aspect of the college activities. It is our hope that with this development the college will be able to approach the whole problem of assessment and examination of the candidates based upon the very sound and well founded basis of assessment, which has been the subject of extensive research.

Dr. Wilson has already demonstrated the value of this approach. You asked, or we were asked, particularly concerning the differences which exist as far as the Royal College is concerned, compared to similar bodies in other countries. In the United Kingdom, the colleges have offered some recognition, based on examination, which is really more an entrée into further training, whereas our approach has been to assess the individual after what we have considered to be an adequate training.

Compared to the situation in the United States, our college is somewhat similar to the bodies in the United States, but differs again. In the United States our specialty in the practice of medicine is assessed by an individual board of examiners, and some 20 or more boards exist.

I think the unique situation in Canada which we have is of value to all of the specialties within the practice of medicine, being represented within the Royal College in one body, so that we have a great advantage of interchange of ideas and interchange of concepts in this development. I think this is the most I can offer in answer to Senator Sullivan's question.

Senator Sullivan: Thank you. I have no more questions to the Royal College.

The Chairman: This is a general discussion. I do not think we should put all the questions to the same body. If no one is ready to ask questions, I would like to ask a very provocative question of Dr. Copp. Do you not think we are spending too much money on research on cancer?

Dr. Copp: That is a rhetorical question.

The Chairman: The purpose of my question is that I was reading an article by a great American scientist, Alvin Malberg, the other day. He was not in medicine, of course. He was saying that very often we tend to spend money on a particular thing, and when that particular discipline is not able any more to make progress—because the other related sciences—in your case, perhaps molecular biology—or any related science, has not been able yet to make its own contribution, so that cancer research can progress. In relation with your related sciences, of course, everybody is against cancer, and you told us that you were receiving a lot of financial support for your research. I think it is very desirable, but do you not think that there might be some kind of lack of balance there, and that the more fundamental science has been neglected.

Dr. Copp: Mr. Chairman, I have one advantage, that my own research field is not the cancer field, so that I can take a quite unbiased view of this. I feel that the support of research through the National Cancer Institute and other cancer research bodies, covers all of the fundamental fields of research, even though it is mission oriented—

many of our groups are working on molecular biology, the fundamental aspects, as it pertains to the growth and development of tumours. On the other hand, one must recognize cancer, our second most killing disease, is not going to be cured by a simple magical formula like polio vaccine, so the problem will be a continuing one. To try to assess whether we are spending too much in Canada, we have to look at what is being done in other countries. We lag considerably behind France and far behind the United States which is now spending through one agency alone \$200 million a year in federal support of cancer research. We are spending in this country \$4 million. So I don't think we are spending too much in Canada in the cancer field. I don't think we are in fact spending enough for a disease of major importance where research is the only hope for some success in combating it.

The Chairman: Don't you think they are more likely to find various solutions to this problem with \$200 million in the United States?

Dr. Copp: This is one of the arguments these people have; they ask why we should spend any money on research, when the Americans will do it anyway. This may apply so far as space research is concerned, but, I think, if we do not do our share, we are going to lose our scientists to the place where the work is being done and we will become a colony and not a nation. And I have no desire to be an underdeveloped colony of the United States, thank you. I would like to see our research work, with the resources we have, as fine as that done anywhere in the world. It is the only way we, as Canadians in this country, are going to go ahead.

Senator Carter: Is the kind of research done in Canada along different lines than that being done in the United States and in Europe, or are we duplicating research?

Dr. Copp: In science there is very little duplication, the reason being that it is an international effort. If you merely repeat someone else's work, your work is not recognized and your work is not published.

Senator Carter: How is the work coordinated all over the world?

Dr. Copp: It is done in a number of ways. For example, it is done through the Interna-

tional Union for Cancer, which holds international conferences, and meetings and publishes a journal. The secretary general, the head man in this union, happens to be Dr. Taylor, who is a Canadian and who is sitting in the audience tonight.

The second way is by scientific meetings. The National Cancer Institute, for example, has developed a biennial meeting which attracts leading scientists from all over the world. It is considered a prestige invitation and we have had a number of Nobel prize winners come to these meetings where we bring together Canadian scientists and grantees, and then these outstanding people, both from inside Canada and outside Canada, meet for three or four days in an isolated community. As a matter of fact, it is Honey Harbour, and yet they are so keen on science that they don't even go fishing very often.

Now, this is communication.

Canada holds a very respected place in the world in medical research in general and also in the field of cancer research, specifically. For example, the Ontario Cancer Institute has one of the outstanding biophysics groups in the world working on problems of radiation biology and radiation effects on cancer.

Senator Robichaud: Mr. Chairman, attached to Dr. Copp's brief as an appendix is a budget forecast for the next four years. I notice that, as sources of income, there are listed the federal Government, the Canadian Cancer Society and "other", under which there is forecast \$135,000 for 1969-70 and \$140,000 for the next three years. Could we have an idea who these others are?

Dr. Copp: I will refer that question to Dr. Taylor, since he is the head of the head office.

Dr. R. M. Taylor, Executive Director, National Cancer Institute: Mr. Chairman, the other sources are such things as bequests which are occasionally left directly to the National Cancer Institute. We have a regular grant from the King George V Silver Jubilee Fund for Cancer, and we have had, occasionally, in the past 10 or 12 years special grants from, for instance, the tobacco industry to carry out research in the field of their interests.

Senator Robichaud: I notice you are forecasting a deficit of approximately half a million dollars a year for the next four years. This shows that you must have faith in the

future or perhaps the institute is expecting a portion of the savings from the abstainers from cigarette smoking. In this connection I may state that I personally stopped smoking 25 years ago and the day after I stopped I took out a 20-year insurance policy which has now been paid for 5 years out of the savings I made by not smoking.

Dr. Copp: That is known as double indemnity insurance.

Senator Grosart: Mr. Chairman, in the same table, appendix E it seems rather anomalous that you should have directed this question to the National Cancer Institute, because they have the distinction, if I read correctly, of being the only one of the hundreds of institutions who have come before us who have projected a budget that was not asking the federal government for any more for the next three years.

The Chairman: My hope was that they might contribute to increase the funds available to the Medical Research Council.

Senator Grosart: This is doubly important in that this is the first time that anybody has projected a budget for us, and this also happens to be a budget that remains constant in respect of federal government support until 1972/73. I think you are to be congratulated on that, from the point of view, not only of the federal government but of the other claimants for federal government support.

Dr. Copp: We are not perhaps as virtuous as we might appear from this table because while we have left this figure standing as it does, you will notice this progressive increase in the deficit, and it is our hope that the funds from the federal government will be increased to permit the growth of the program which is planned in the projected budget. The point is that without some other source of funds or a tremendous increase in public giving the research program will have to be sharply curtailed. However, we are honest enough to say that the decision is a government one and not one that we can make.

Senator Robichaud: Maybe Senator Grosart has omitted to look at page 2 of the summary where it says:

It would be of advantage to the medical research program in Canada if the Gov-

ernment were to enter into a matching grant program with the voluntary agencies. Such an arrangement would also be of advantage to the Government in that its investment in this form would have a two-or-three-fold yield in terms of research effort.

Dr. Copp: I am sorry, Senator Grosart, if we have shattered your admiration.

Senator Grosart: You have not. I have read the brief and while you do make reference to the matching grant policy, there seems to be an assumption that anybody who says matching grant means matching amounts.

Dr. Copp: You will notice we do not mention this necessarily as equal matching, but as a *pro rata* formula.

The Chairman: Dr. Brown and his associates who were before us a couple of months ago explained to us their approach which is a very normal one for federal granting institutions. They said they were more or less broadly speaking passive and waiting for applications for research grants. This is in their terms of reference and is perfectly normal. But I wonder if, as a result of this kind of system, over the years there might be a kind of imbalance or imbalances developing between the different disciplines which are represented here. How can this balance be preserved with that kind of system, when the individual researcher presents his own application and hopes it will be accepted on the basis of scientific merit? I would like to have some comments on the kind of balance. You have seen this development in Canada. The Medical Research Council has been in operation, in its new capacity or in its former capacity, for a few years now. How does it strike you, the kind of balance that we have reached between the different disciplines, related to your professions or research activities and the whole field of biology?

Dr. Cinader: Mr. Chairman, I think there are very natural evolutionary processes which regulate this. One is that any investigator really lays his life on the line when he investigates: this is his career, his future, his spare time, his evenings. Therefore, he will apply the criteria of excellence to this, and if he is any good he will say, "Is that something on which I can make an original contribution?" That area shifts because, of course, the original contribution yesterday is the dull, text-

book stuff of today, so there is a continuous process in which investigators themselves, on the whole, shift the area of their work, and the best shift most in this direction because they look for fundamental problems to investigate. So the pure judgment of quality contains originality in it. There is, therefore, this automatic adjustment when you have a peripheral initiative, as we now have it.

However, I have already in my own submission mentioned that there are inertias at other levels which create difficulties in this adjustment. Therefore, there is a need for a look occasionally by certain bodies at where we seem to be going and to attempt to plan and put forward, possibly in the form of contracts and possibly in the form of initiating groups and giving encouragement where people do not quite expect it, to give a little bit of push occasionally in certain directions.

Dr. Taylor: I think the balance that you refer to can perhaps be illustrated this way. In the first place, reference has been made tonight to the number of people here who are wearing several hats. In the Canadian scene, interlocking of directorates of various organizations is such that I think this is one guarantee of balance.

The other factor that can be commented on from the point of view of the National Cancer Institute, by way of illustration, is that in 1950, for instance, when the cobalt bomb therapy unit became available, there were not sufficient radiation physicists in Canada and, recognizing this problem, the Institute in fact enlisted or recruited people to enter the field of radiation physics, and for a number of years after that was, I think, perhaps the leading agency, governmental and non-governmental, in Canada supporting research in radiation physics and radiation biology. That need was met, and the physicists took their role and so the Institute withdrew from that field.

There was a period we are proud of when, for a few weeks, the National Cancer Institute was the largest source of extramural research support in Canada. With the growth of the Medical Research Council I think the National Cancer Institute will obviously and is now defining its objectives more clearly and more narrowly and withdrawing from certain areas which the Medical Research Council is now supporting.

Senator Carter: Mr. Chairman, along that line I think one of the witnesses tonight

indicated that there was a shortage of pathologists and also a shortage of specialists in anatomy. Is that a type of imbalance that is cropping up in our medical schools? Is that something that should be corrected?

The Chairman: You have been silent up until now during the discussion period, sir.

Dr. Ritchie: Yes, Mr. Chairman; I would hope very much that it would be corrected. The correction of it, though, is a difficult and complicated matter. Speaking as a pathologist, if I were to outline a perfect development of pathology I would have nobody left to enter surgery or any of the minor specialties. Just where this balance should be drawn is a very complicated matter. Then we have a second problem here, not only to train enough people but to train them in the proper fashion that will fit them for the needs of the future, the future which changes so very quickly in this area.

Senator Carter: Are you saying we do not have enough facilities? Is that why we do not have enough?

Dr. Ritchie: At the moment I do not think there is any university in Canada that has enough facilities just in sheer bricks, mortar and space, to have the kind of pathology department it should have. There certainly is insufficient staff and because of this block we cannot train the numbers of people required.

Senator Sullivan: I think that is the message Dr. LeClair was trying to get over too.

Senator Yuzyk: Is there any attempt to establish centres of excellence? You cannot scatter this all over the country; certain aspects could be concentrated in a particular university or a particular district.

Dr. Ritchie: Yes, I think this is essential and on two different levels, which are inter-related and intermixed, but if one looks from the point of view of health care in the community, every hospital everywhere cannot have every specialty. The specialties should be grouped in appropriate centres of appropriate sizes to serve this purpose. This is one form of grouping. Similarly, on the scientific side, everybody cannot do everything.

What we need is to have in each centre reasonable strength, that is enough strengths and have between the centres a correlation so that overall we do in fact do everything that is required.

I would not be in the least reluctant, speaking again specifically of pathology, to have in Toronto say some aspect missing altogether if I knew we could obtain that particular service or send a man to obtain that particular kind of training to anywhere you like, Ottawa.

The Chairman: Could Dr. Evans comment on this? I know he is in the room.

Dr. John R. Evans, The Association of Canadian Medical Colleges: Mr. Chairman, the matter of balance I think is an extremely important one. Perhaps I can take an unpopular stand here because it reflects disagreement with the presentation. I believe that we will have difficulty if we divide money into very sharp missions and packages. I believe that the voluntary agencies have played a most important role and should continue to do so.

In order to make the peer system work most effectively the base for judging peers must be very broad; it must go beyond a single area, a subject of pathology, disease, of cancer and money must be taken away from one area if the quality of the research is not effective and put into another more promising area. I think that this balance can best be met by the broadest type of research granting organization. This is the reason why Dr. LeClair has mentioned in his submission that the medical schools, through the Association of Canadian Medical Colleges, feel that the Medical Research Council is the broad type of granting agency that can best support and have the leadership of developing medical research in this country.

I should like to mention one other aspect of balance, and that is the balance between fundamental research, more applied research, operational research, and developmental research. This balance has not been met well in this country today, and I believe that we have to look at achieving a balance between these various parts of research. If we translate them, what do they mean? Fundamental research is what we are doing for the next generation really, because the benefits of it to health will not be immediate. Operational and developmental research are those things that we might hope to have some benefit from almost immediately.

When the Government of Canada introduce a method of financial health care which will change the character of the delivery of health care, and which will promise a better system of health care to Canadians, it is absolutely

essential that we are able to provide not only manpower, but also the system for the delivery of this health care. We cannot do that at the present time through the medical schools because we do not know the answers for the system.

Operational research is very urgent and must be developed. It is very expensive research, and if we say, "Here is the amount of money available for research. We must now turn it all towards operational research," what we will really do is short change the next generation, because we will not provide the fundamental research to develop the discovery which will in five to ten years be the best for operational research and developmental research.

Therefore, while I am very sympathetic to Senator Grosart's question, I think it is very dangerous to think of developing research without an increase in expenditure. There is a commitment to provide a better system and a more extensive system of health in Canada at the present time. This involves the education of more people, discovery of systems, regional planning, the correction of regional disparities and many other things. We have not really started to invade the research area there to find the answers, and we have not got a system on which to proceed, so it is most important that this be studied and well supported financially. If this is done at the expense of all the fundamental research, then I think we can expect a very serious problem in terms of the morale of our scientific community, in terms of the standards of education in our schools and universities, and in terms of what we leave for the next generation or the next decade that will be upon us.

Why is this important right now? The answer is that the Health Resources Fund stimulated a tremendous sort of buoyancy and optimism in planning for a new era of health services in Canada, and with this we now have an era of rapid build-up, and what we do in this next five or six years will set the pattern for at least a decade. To go very slowly now and not recruit high quality staff, not establish the basis for good programs, will not be seen as much now as it will in five to seven years. Therefore, Mr. Chairman, I feel that while we must all appreciate this need for stringency and economy—you must be tired of hearing from groups that always have a special reason—you must also appreciate the policies of government in relation to health care that have been enacted recently

and the considerable questions that are involved in terms of quantity, quality and distribution of health care that relate to research at all levels.

The Chairman: Thank you.

Senator Grosart: I think I have been misunderstood here. I believe that I have made it clear over the last 50 or so meetings of this committee that my impression is that there has to be a very substantial increase in the federal funding of research. I am not sure at the moment as to what percentage of the increase should go to medicine or to any other area of research. I do not think I am in a completely isolated position as far as those who are thinking about the problem in Canada at the moment.

This committee has to be concerned with the general dimensions of federal funding of research and this, of course, has two aspects; the needs aspect and the money that can be made available.

The Chairman: And other needs.

Senator Grosart: I am now talking of the whole of research needs as against all other claims there are on public funds. The alternatives are obvious, either there has to be an allocation of funds that nobody will be happy with or there must be higher taxation. I am not coming down on the side of any particular—

The Chairman: We had the budget speech last night.

Senator Grosart: —solution at the moment. It is very interesting to look through the briefs that we have here. There is not very much guidance to us as to what the total dimension of federal funding for medical research should be next year, let alone the years ongoing. As far as I can find from the briefs, the total at the moment appears to be \$44.5 million. Is that the correct figure? Will anybody tell me?

Senator Sullivan: Is that correct, Dr. Brown?

Dr. G. Malcolm Brown, Chairman, Medical Research Council: I think that is a little low.

Senator Grosart: I am reading from page 17 of the brief of the Canadian Society for Clinical Investigation:

By 1968-69, total funds available for Canadian medical research, at \$44.5 million, were double those in 1965-66;

I do not know whether that statement is correct or not. I would be interested in knowing what the figure is. Did you say it was higher, Dr. Brown?

Dr. Brown: Forty-four point five million, Mr. Chairman, is the 1968-69 figure; is it not?

Senator Grosart: Yes, 1968-69.

Dr. Brown: I thought you were referring to next year.

Senator Grosart: Not here. In these briefs there is not a 1969-70 figure.

Dr. Brown: This is the amount available, not the amount needed?

Senator Grosart: That is right. I am asking now what is the current dimension? In other words, our problem is to consider what additional funding there should be, because every single brief says that there should be, even the one I refer to. I want to know where we start and what kind of money we are talking about. We are up against the problem that has been before us and I think in practically every request we have had for funding, nobody can tell us what the funds are at the moment. Can anybody give us the information as to what percentage this 44.5 million or whatever the figure is of the total expenditure on research or is this the total? It says the total. It does not say, although the context may indicate that it is federal funding. I am not sure. Is this the total funding?

The Chairman: For Canada as a whole you mean, including the private sector and the other federal departments?

Senator Grosart: I am just reading the sentence—

Dr. Wigle: This includes all voluntary agencies, including the Medical Research Council.

Senator Grosart: What percentage of this total, if this is an absolute total, is provided by federal funding at the moment? There is a figure for a year back, somewhere, which estimates it to be 75 per cent. That is in the National Cancer Institute brief at page 5.

Dr. Taylor: The 75 per cent figure,—the 25 per cent from the private agencies was based on a computation of the totals being con-

tributed by all of the agencies, voluntary agencies, that participate. In a collaboration agreement once a year. As the brief of the institute mentions, that proportion of the total has been relatively constant for the last few years.

Senator Grosart: So we can assume, I take it, Mr. Chairman—

The Chairman: I think when Dr. Brown was before us he had this kind of distribution of funding as between the federal agencies and voluntary organizations, and all this. So I do not think that the people here would have all the figures.

Senator Grosart: I am not suggesting they should, but in the discussion it is very useful to know what we are talking about. We are going to be talking, as Senator Sullivan suggested, about money.

The Chairman: I hope we will not talk only about money. It is so prosaic.

Senator Grosart: It is prosaic but it dominates the thinking in the briefs and, rightly or wrongly, the federal Government can express its policies in terms of research largely in terms of money. This is what the science community keeps saying, give us some money but do not start making research policy. So we are forced back on the consideration of the money aspect. This is the kind of dimension that the science community is working for in the federal judgment, so I say it is important.

The Chairman: It is important, of course.

Senator Grosart: I would like, but I know you will stop me—

The Chairman: I have never stopped you. I cannot.

Senator Grosart: You could try. Mr. Chairman, I would like to ask each of the groups before us to give us a top of the head estimate of how much the funding of their discipline or their group of disciplines should be increased next year or in the next couple of years, to deal adequately with the major problems that are before us in these briefs.

Senator Sullivan: Do not be bashful.

The Chairman: I will not have to stop you.

Senator Grosart: I would be interested. If they say they need 25 per cent more, or 35 per cent more. We have before us phrases such as the "enormous gap" which I think is a quotation from the Royal Commission on Cancer. We have a statement, and perhaps someone would comment on this—this is in the brief of the Canadian Physiological Society, at page 9. We have the statement that the funding of medical research in Canada is not commensurate with the levels in Sweden and the United Kingdom. It would be interesting to know what those levels are and how much our funding is deficient. You see, we have these statements and, I think, if we are going to make a report, we should at least be able to come up and say that the present level of federal funding of medical research is X percentage lower in the opinion of the medical community and in our opinion is such and such an amount.

The Chairman: I will certainly allow that question, senator, because I know that you don't know the answer.

Dr. Copp: Mr. Chairman, it would be not inappropriate, if we compared our research and development efforts on the basis of our gross national product and to parallel that in other developed countries such as the United States, because we are really very comparable in our standard of living. The United States and Sweden are probably the closest to Canada. I think the most objective thing is to see what they are doing and consider this particular proportion.

In the case of medical research, this would come to somewhere around \$100 million from federal sources. That is the dimension at the moment.

Senator Grosart: What would come to \$100 million?

Dr. Copp: One hundred million dollars per annum is the support for research in the health sciences in Canada.

Senator Grosart: If we were to reach the level of the others?

Dr. Copp: That is right.

Senator Carter: What we want to know, though, is how much we would need to fully utilize our present capacity. What have we now in capacity that is not being utilized? And then, in addition to that, we would want to know what we need for extra facilities to

bring our level up to the level of other countries, say, Sweden. So it is a pretty complicated question.

Dr. Copp: I would think Dr. Brown might have some answers on that.

Dr. Brown: Mr. Chairman, I think the question has just been posed in a very good way: what is the amount required adequately to exploit the resources that we have now and not to cover an ideal situation which may be to some extent unreal.

In 1968-69 there were available some extramural sources, as mentioned in Dr. Magner's brief, all extramural sources covering the so-called direct costs of research. This is one measure of research volume. It is not the total costs of research, because a good part of the total costs are left to other channels. This is one measure and it is one which the federal Government is closer connected with when it takes out its own supportive research under the label of research. This was \$44 million. Our component of that was \$27 million.

We turned down good applications of the order of another \$4 million to \$5 million. This present year our budget is increased by 12 per cent. Nevertheless, the amount of good work that is going by the board is going to be greater. I will just give you one or two illustrations of what I mean. In connection with new proposals, including all of the proposals from new faculty members this year, we are able to make awards only to the degree of 33 per cent. Just 33 per cent.

The devastating effect of stop and go financing has been mentioned and its long-term effects have been emphasized by Dr. Evans and by others. In our own fellowship program this year we are actually able to award fewer new fellowships for research grants than we were last year. We are not able even to hold the line. We are awarding a few more fellowships over-all because we are giving renewals. We are not cutting off people in midstream. But the standard of applicants was never higher this year and yet we have to give fewer.

This is what is happening, Mr. Chairman, with an increment of 12 per cent.

Now, the order of growth has been asked for. What might it be? Well, to put it in the terms mentioned by the senator, in terms of the people and facilities, there are increases in the order of 30 per cent over-all and, if this total is to be maintained, the federal component would have to be even greater than that.

The biology growth rate is about 8 to 10 per cent year, and that is all. The R & D component is stationary. The DVA component is stationary and National Health and Welfare had an increase this year of a sizeable amount for the first time in quite a few years. It had been stationary up to that. So in the overall the federal component has stayed with the voluntary component but if it is to reach an overall level to match the growth in personnel it is clear that the MRC must grow even greater.

Senator Grosart: So that the 35 per cent annual increase over the next three years, other conditions being equal, will bring us up to the level of the United States and Sweden. That is the dimension I am asking for.

The Chairman: At their present level.

Senator Belisle: Am I right in my belief that when we were in Washington we were told that our approximate \$800 million spent on this kind of research was the equivalent of their \$25 billion and that we were on a par with them?

The Chairman: We are still not on a par—\$800 million compared with \$25 billion.

Senator Belisle: But based on the proportion of population which is 1 to 10.

Dr. Evans: I would like to say that I was very encouraged to hear Senator Grosart mention three years. One of the problems we have had is this oscillation in the amount of increase in funds for research. About 1965 there was a 33½ per cent jump which is about ½ plus an additional \$3 million which was a very substantial amount. Then there was 33 per cent per year for a number of years, and then at the time of the budget there was an announcement by the Minister of Finance that implied a cutback in the rate of funding for research. That announcement was spread very widely and very quickly. It was one bit of news that travelled very rapidly over the wires and people said "we knew it was too good to last in Canada".

The Chairman: Was this in October?

Dr. Evans: I believe it was September, in Mr. Sharp's announcement. I believe this had a tremendous effect on morale and a fall in recruitment because it was felt that we were no longer interested in Canada in scientific development. The cutback this year is obviously at a very much reduced rate but it has reinforced that opinion in the minds of many

young investigators who returned to Canada with good scientific training and it meant that they could not be supported with the funds available to MRC. This is a most difficult situation. We should be prepared to live with inadequate funding in some year in the future, but at the same time we should be able to plan on a longer than year-to-year basis. There should be a period of three years or so for which we can predict, because the time to build up these programs is much more than can be made by a year-to-year notice of the funds available.

The Chairman: Are there other comments on this?

Senator Robichaud: I have a question which might seem a little contradictory to the statement we have just heard.

Dr. Moore, on page 1 of your brief, in the "Summary of Main Conclusions and Recommendations," you said that:

Good job applicants and members of staff are attracted to other countries, especially to the United States, where support for specialized anatomical research is easier to obtain.

Then you say:

The situation is not as serious as it was two years ago but it still exists.

Then you recommend:

Increase funds to the Medical Research Council and the National Research Council for research.

What is the main reason for this decrease in emigration in the last two years? Could it be due, in part, to the assistance provided by the Medical Research Council?

Dr. Moore: Mr. Chairman, in answer to that, in our own particular discipline, because of the increased teaching that has been required especially for paramedicals and dentals—there has been an increase in dental schools and physiotherapists—this has necessitated a great increase in the number of staff. In my own department the staff has more than doubled in four years. This means a tremendous increase in the number of new people coming into the department, and Dr. Brown said that only 33 per cent of the new faculty were able to be supported.

In my own department two of the good young men were not supported. One has gone to the United States, and the other is on his way, mainly because they were not support-

ed. They were told, when the applications were turned down, that their research was good but that unfortunately insufficient funds were available to support them. There are already good projects being supported, but many good ones are turned down because of lack of funds.

In some other disciplines there are people from the United States coming into Canada, but in my own particular we are losing not only the good ones we attract, say, from Great Britain, but also some of our own graduates because of these problems.

The Chairman: Quite apart from producing good doctors, and we all need them, especially here in this institution!

Senator Sullivan: For liver transplants!

The Chairman: Not only that.

I would like to know what have been in recent years in Canada some of the interesting contributions to the progress of medical science as a result of the money that has been made available to and spent by our researchers. I understand, of course, that the bulk of the money is going for training people, and all that, but apart from that, I am sure we have also some excellence and we are contributing to the progress of science.

Dr. Wigle: On pages 6, 7 and 8 of our brief—that is, the brief of the Canadian Society for Clinical Investigation—we list seven areas in which we feel Canadians have made significant scientific contributions and contributions that are today leading to improved health care for Canadians.

For instance, when people have heart attacks there are special care units they go into now. This was first started in Canada. There have been members of the federal Cabinet who have had special heart operations to bring new blood to their heart, and this was a Canadian development.

There is a number of things. We have one of the best rare blood banks in the world, that has been developed here in Canada. In areas of high blood pressure research there are two units in Canada that are internationally known and have contributed to an understanding of the causation and treatment of high blood pressure.

Mr. Chairman, you are sitting next to a man who discovered a new hormone, and it is perhaps significant that calcium in the blood is important for muscle contraction. It is important in bone formation and yet the two

most important hormones that are known to man in regulating blood calcium have been discovered by Canadians: one, Dr. Collip discovered parathormone; secondly, Dr. Copp with calcitonin. I think in these pages are listed some of the areas in which Canadians have contributed to medical science.

The Chairman: I knew about these things, but I do not think there is enough information being diffused to the public about them.

Dr. Wigle: To the public or to the practising physician?

The Chairman: The public too, because ultimately if we want to get more money for research the public will have to pay, not the practitioner.

Dr. Wigle: This is one of the reasons and I think this is one of the first times that an organization in Canada has come out boldly, because doctors and scientists are usually a timid bunch and tend not to speak of their accomplishments.

The Chairman: Especially if they are Canadians.

Dr. Wigle: We purposely in this brief set out to indicate this. This pamphlet will be made available to the public and we hope distributed widely. We hope that we can lead to some education of the Canadian public and that on that day they will be proud of their own Canadian accomplishments, because they have good reason to be. I think at the same time many of these accomplishments have been made at a time when it is very difficult. To quote, Canada's position in medical research is overall one of modest accomplishment, but in the areas where we have accomplished things I think that those who have accomplished them under these conditions can indeed be proud of themselves. They are there and in our brief we are attempting to disseminate this knowledge.

I think it is also important that it be disseminated, however, to the practising physicians in the country. This is again where people involved in research are involved in postgraduate programs and continuing medical education. It is important to diffuse this knowledge to the practising physician.

One thing that has not been mentioned here and speaking to Dr. Walter MacKenzie this afternoon he mentioned this. I think it is a valid point: I was looking down this wall here and we have a lot of Canadian scientists

and yet practically every one of them, without exception, received their research training outside Canada. Canada is a well developed country yet where are the best Canadian scientists receiving their training? It has been outside this country and to a large measure it continues to be. I think it is a very important thing too, regarding the comments of Senator Grosart, that the change in the environment in the medical faculties in the last three years, from 1965, 1966 until 1968, 1969, has been tremendously improved. There have been new developments; really the improved environment came after the Medical Research Council budget was increased by an amount of 33½ per cent per year. This is an amount that the Canadian scientific community was very happy with and it was leading to good things in this country. This business of cutting back now, you have heard from some of the speakers this evening of the ill effects it is having and it is very difficult to reverse these ill effects once they start.

Dr. Taylor: Mr. Chairman, I think your question would have provided another argument, if you like, for the voluntary agencies, because in order to keep the public interest in supporting this program of the national Cancer Institute it has been necessary to inform them what has been done with the money. This is the reason I think for keeping the voluntary agencies in the field, because it does keep the citizen in a sense personally involved with the progress.

The Chairman: Are they more informed about the progress of research or are they more fearful of the sickness?

Dr. Taylor: The fear of the sickness was the reason why the Canadian Medical Association 30 years ago suggested that there was a need for a voluntary agency to educate the public, because the medical profession was not doing it very effectively. The fear is something that has been built into our country, and I think it is a continuing problem. Speaking at least for the organization I represent, one does not attempt to raise funds by increasing the fear of the public; you really do not get very far in the long-term.

There are accomplishments in the field of cancer research that one could mention. I think one point that was not mentioned, to which reference might have been made, is that one estimate of the value of research in a country is to look at the peer judgment. I think one does it by looking at references to Canadian research in international journals or

journals in other countries. Doing that, one has a match of the regard that scientists in other countries have for work done here, and I think that Canadian research stands up well in such a grouping.

Dr. Ian Rusted, Vice-President, the Royal College of Physicians and Surgeons of Canada: There is one aspect that has not, I think, been mentioned. I am sure the committee is aware of the length of medical education: usually three to four years college pre-medical education, four or five years medical school per se, and then four, five or six years post-graduate medical education. In spite of this I think we are all rather relieved in a way to be able to admit honestly that it still is not possible to come anywhere near knowing all there is to know. Therefore, medical teachers must be selective in what they teach; they must choose areas and probe in depth. This means that "cookbook" exercises in laboratory research, so-called laboratory methods, are no longer enough. Again in postgraduate medical education the students must be involved with real research and real researchers. This cannot be in the United States, it cannot be in Sweden; it must be here in our medical schools in Canada. Obviously this is a joint need that the Association of Canadian Medical Colleges, the Royal College, the Medical Research Council and most bodies represented here tonight are happy to support. Clearly this is one very important reason why there needs to be this increased support for faculty members to teach and at the same time do research in addition to fundamental research for its own sake.

Dr. Brown: Mr. Chairman, honourable senators: I think the point has been very well made that the Canadian public does not know enough about the accomplishments of medical research. Much has been said about training, the need to train and the effect of research on training, which has perhaps sometimes given the impression that this really still a start-up operation. It is rather beyond that. This year, for instance, there are about 2,400 research trainees in the medical schools and colleges across the country; there are some outside, a larger number than we would like to be outside. However, the size of the training operation is of that order, about 2,400. I would hope that we could by one means or another remove the too common impression that medical research is simply a lusty infant requiring ever more and more injection needles, and get across the impression that it is a

proud and accomplished if rather emaciated adult.

Senator Carter: I should like to change the subject and return to the Association of Canadian Medical Colleges. In the presentation, I think Dr. Evans referred to the national role.

Dr. LeClair: Mr. Chairman, the ACMC is not involved in the accreditation of hospitals. It is involved with its American counterpart in its accreditation of medical schools. However, the Royal College is involved in the approval of hospitals. There was an experiment in the west recently and this will be done again, that both bodies do the accreditation of one institution, the medical school and the teaching hospitals at one time in one city. Both bodies are now trying to do this at the one time.

Senator Carter: As part of your national role, are you consulted when new schools are being set up? We have set up one, Memorial, in St. John's. Were you involved in the investigations that led up to the setting up of that school?

Dr. LeClair: Yes, sir. I was not involved personally. I was not with ACMC at that time. When Memorial was set up there was a very serious study done and ACMC was consulted at that time and was in favour of a medical school. This was done for our school. ACMC has been consulted on many occasions for the establishment of new schools and recently for New Brunswick. It is because of ACMC facilities, itself, and the people that are there available that they can provide some measure of ultimate success of a new school.

Senator Carter: You do not accredit hospitals. Do you accredit various schools?

Dr. LeClair: It is a liaison committee with the Association of American Medical Colleges. The Canadian and American people do this together and the accreditation is for medical schools, not hospitals.

Senator Carter: How big a factor does scientific research play in these assessments?

Dr. LeClair: Very much so. I think when we were before Dr. Brown with the ACMC brief we spoke quite a bit about the spinoff.

Mr. Chairman and honourable senators, the contributions in terms of research in new things discovered by Canadians, is as impor-

tant as the contribution of research in medical education. We certainly need more good doctors. A medical school without a good research infrastructure cannot function as a medical school. In other words, research is essential for medical education. I would think this is as important as the gathering of new knowledge in terms of the national...

The Chairman: Probably more important.

Dr. LeClair: Well, medical education is as important.

Senator Carter: Just one other question. I think Dr. Wigle referred to the various contributions which Canadians have made to the medical science, and the Royal College also awards medals for original work. I wonder if we could have a couple of examples of the kind of work you give medals for.

Dr. James H. Graham, Secretary, the Royal College of Physicians and Surgeons of Canada: The Royal College brief mentions that this is a rather modest effort, the reason being that the prestige value perhaps of the award is of particular value, without it being a high monetary amount. This is an annual affair. The original research is submitted in essay form. The submissions usually are from five to ten in number in each of the divisions of medicine and surgery. The winner of the award presents his material at the annual scientific meeting. Is the senator interested in examples?

Senator Carter: The type of original work. You referred to original work and I wondered what type of work it is.

Dr. Graham: It could be basic or more practical. One award given a few years ago was for basic studies relating to cardiac surgery for myocardial infarction, in Toronto. This year another award in Toronto was in regard to studies on the physiological basis of the functioning of the Vineberg operation. These can be biochemical or they can be clinically oriented.

Senator Carter: It could be a new method of treatment or a new method of search? It is similar to what is mentioned in the other briefs that Dr. Wigle was referring to?

Dr. Wigle: Sometimes the essay awards have been very basic. One was for work on functions in regard to a hormone from the thymus gland. This is something which is important in immunology. These awards vary

greatly from basic research to more clinical or applied research.

Senator Carter: It is a pity this is not more generally known. These are hiding their lights under a bushel.

The Chairman: I think all the medical profession should hire good public relations men. We have one who is a member of our committee and he has another question to ask. Senator Grosart.

Senator Grosart: If I might turn my questioning from the quantitative aspects of research funding to one part of the qualitative aspect. I would like some comment on mechanisms, research contracts and grants in aid.

I find two statements in the briefs very interesting. One is in the brief of the Canadian Physiological Society, which discusses perhaps the most terrible thing in the whole area, value judgments by nonscientists. It says that this could influence the type and quality of research done, and so on.

Then I find a phrase "that the responsible administrator of public funds might elect to use a research contract method, although this is anathema to many scientists, for various reasons."

In the brief of the Canadian Association of Anatomists, I read that they have also found "that the present grant-in-aid system alone inhibits to some extent truly imaginative research and favours more routine work, likely to receive grant support."

In all the disciplines this question comes up over and over again, not only how much money, but how do we get it, what are the preferences in the various disciplines in medical research, between various types of funding. Are research contracts really anathema? Are there times when grants-in-aid really inhibit?

Dr. Moore: Mr. Chairman, with respect to our comments about this, we do feel that there are sometimes research applications that are not accepted, if this is a completely new line of research and there has not been other work done on this, and we feel if there were funds made available as are now done to medicine, if these were made to heads of departments, this would enable them to support the research of some new investigators and some of the older ones who have work they would like to do but know they are not apt to get support for. I think most of us

know what type of research we can get support for and I think I am as guilty as anyone in doing the pilot experiments either on my own funds or in other methods of private research funds that I have won, and I have tried to raise money, but I guess we don't do enough publicity. But we need funds to support these projects which may not gain support if they are put before a committee because there is only so much available research money, and this will go to the projects where it is sure that they are going to get results.

When we are talking about the results of Canadian research, I think one of the best examples that have come forth from the anatomists concerning genetics, which is not peculiar to an anatomist. If I might mention his name, Dr. Barr won the Kennedy Award. He was one of four people in the world to receive that award and the \$25,000, and he has won other international awards as well. He has won, however, few Canadian awards. There is not too much publicity of this research, but I can say that Dr. Barr and his group have been leaders in genetic research and have stimulated tremendous new research in intersexuality.

Fifteen years ago very little work was done in this very sad condition, but now, as a result of this Canadian stimulus...

The Chairman: It does not apply to us.

Dr. Moore: It is a very prominent area of research and has now been adopted, as you know, in the Olympic Games and so on. This has caused considerable trouble, of course.

This all began with basic research which Dr. Barr initiated after his work in the air force study of fatigue. This work was supported by the Defence Research Board, I think, and then later by the National Cancer Institute and at the same time by the Medical Research Council. It was very fundamental. It has now developed into one of the most promising areas and has been compared with Banting and Best's discovery of insulin.

I would have been remiss had I not mentioned it. I don't think you will find a more modest person in Canada than Dr. Barr, however, and I am sure his colleagues from the University of Western Ontario would agree with me on that. He has received acclaim from around the world, but in Canada very few people outside the medical profession are aware of his world-wide contributions.

Senator Grosart: Dr. Moore, were you relating that to my question as to the relative merits of grants in aid and research contracts? I mean the first part of your answer?

Dr. Moore: I think the grants in aid system in general is a very good thing. I think there is a need for these other funds for supporting these new projects, the new sort of things. The contract research does not apply so much to our discipline, although there are facilities through the MRC for group research and so on and we have some of these groups.

Another area of excellence is the electromyography which has happened to be centered in anatomy. We have now lost the president of the electromyography society to the United States. He takes with him some of our specialists in this field. The only reason that this expert has gone to the United States is because he has been able to get a research institute and all the funds that he needs, which he was not able to get in Canada. And he is taking with him good people. He says he will come back in two or three years if he can get comparable facilities in Canada.

This is one instance that I know of where we have lost a man of international acclaim to the United States because he could not get the type of facilities he wanted and he could not wait four or five years to get them.

Senator Grosart: But how would he get this, by grants in aid or contracts?

The Chairman: I do not think the doctor was really concerned with these two methods of assistance. He was also mentioning that the head of a department could also have some kind of fund to help his own teachers or professors or researchers. I am a bit worried about this.

Senator Grosart: But I am still asking what kind it is.

The Chairman: It puts the head of a department in a very difficult position. Perhaps it might be a good way to achieve more security for university presidents if they had a fund like this.

Dr. Moore: This was only a very minor point so far as it refers to the heads of departments. But the funds could come through the Medical Research Council and in such a way that they could only be used to the best advantage possible. It would have to be spread among the departments and one could not visualize the same amount going to all the

departments. So far as preventing the situation is concerned, I think an increase in the amount to the Medical Research Council could have prevented this but also private funds could have developed this kind of research institute. It is the medical biological research institute which he is setting up down there and we attempted to have such a unit in Winnipeg but could not come up with the \$40,000 or \$50,000 it would take to support the program.

Dr. Ritchie: I think in answer to Senator Grosart's question, and to answer it more directly, research can be supported satisfactorily in different ways under different conditions. I agree very strongly that it is most important that the departments have a kind of floor, and I do not think it need be a very large floor, but it should be a continuing fund available to them. Whether this money should come from the university or the Medical Research Council does not matter very much, but it must be secure and continuing from year to year.

Senator Grosart: When you say departments, what are you referring to?

Dr. Ritchie: Well, in my own medical school in the Department of Pathology there would be so much money available for research work and this would be given at the discretion of the department. It would be a relatively small amount. In addition I would think the majority of the work should be supported by grants in aid.

The Chairman: When the money would be given to a department, would it be administered or allocated by a council of the department or by the head of department?

Dr. Ritchie: I think this would be a matter of local decision. It comes down to a question of the philosophy of those governing the departments. I would prefer a council to advise the head of the department, speaking as the head of a department. However, I would not make a rule in that regard. The essence of this is that it should continue.

The Chairman: I was head of a department, but not of medicine, and I would not like to allocate for research among my own teachers. I would not have lasted very long.

Dr. Moore: I think it would be done by a committee, but I think the protection that one individual would show how the money was spent and what came of it and so on. Some of

these things of which you are speaking are supported by university funds. Our university now has funds available for new staff members because they know this is a great need, so they will provide them with some funds until they are able to get outside funds. However, this problem I was speaking of here, of the allocation to departments, is only a small part, and I would not want it to get out of proportion to the overall need. I think the main thing is through grants-in-aid through the Medical Research Council.

Senator Grosart: I think you are going to discuss the contract and other methods.

Dr. Ritchie: I look on the phase we have covered as being the raw but very essential basis. Speaking for myself, I think grants in aid should be the ordinary way of financing the vast majority of research. I have no objection whatsoever to a contract, assuming always it is directed to a proper purpose and is properly drawn up, with all the obvious qualifications. I can see great advantages not only in having these two sources of support but the support of groups within a department on a more continuous basis.

For example, the Medical Research Council might like to identify a group of investigators within a department and give them some greater security and continuity of continuing support. This, again, is very valuable in selected cases. On the whole, I tend personally to think that research work done in special research institutes, which are not part of a general department or a general medical school, is less profitable. Such an institute may, indeed, make a scientific discovery which is of inestimable value, but it does not have the secondary results which have been emphasized by several speakers, notably by Dr. Rusted, of raising the whole standard of teaching and medical practice in the centre in which it is located.

Senator Grosart: Would you see the Medical Research Council, in response or otherwise, determining the projects for which the aid was granted?

Dr. Ritchie: Yes.

Senator Belisle: What do you think should be done to make the Medical Research Council more effective than it has been?

A Witness: More money!

The Chairman: Apparently there is only one answer to this!

Senator Belisle: I would like to hear comments on this.

Dr. Wightman: I still feel that Senator Grosart has not had a complete answer to his question.

The Chairman: This is not the first time.

Dr. Wightman: I think there are many other things, and perhaps I should not be speaking to this with Dr. Brown here, but I think a tremendously important aspect of research support was referred to by Dr. Taylor as career research support, where you support a man who is talented in research and has on-going projects which are obviously good. The Medical Research Council scholar and associate program has been tremendously important in the development of Canadian scientists.

I think another aspect not touched on, and a very serious problem from the departmental head point of view, is the problem of capital, obtaining money for buildings and equipment in laboratories. It costs \$40,000 to \$50,000 to set up the laboratory for a new recruit to your research institute, and then it may cost another \$15,000 every year for the equipment that he needs and uses up. These are other aspects which require funds in a very large amount and which are used up very quickly. So, I think these are other parts of research support which need to be expanded, and which have been very useful.

Senator Grosart: Would you say the point at which the political decision-making should end is the determination of the possible amount which should be devoted to medical research? Would anyone care to comment on that as a possible piece of national science policy?

The Chairman: I think that this gentleman wanted to comment on this; I will let him make his comment while they reflect and think of an answer.

Dr. D. Magner, Canadian Association of Pathologists: The point I wanted to make came out of the remark Senator Grosart made, could the MRC do any better?

Senator Grosart: I did not say that.

The Chairman: No; it was Senator Yuzyk who said that.

Senator Grosart: I do not want to get into trouble with Dr. Brown any more.

Dr. Magner: Neither do I; heaven forbid. I think under the present situation the rich are getting richer and the poor are getting poorer so far as grants are concerned. The longer established departments, that have good research programs going back over the years, have reached a practical stage, where newer, slower and smaller schools have difficulty in achieving this. In my opinion in some way starting funds should be made available to schools that are trying to get off the ground. Perhaps these funds could be made available on a special basis to start research programs in the various fields.

Dr. Maurice McGregor, member of the Association of Canadian Medical Colleges: I would like to try and answer two questions: One is the last one, posed by Senator Grosart: Should the Government just decide how much money and leave the internal arrangement thereafter to the bodies that are already set up? I would say undoubtedly in Canada at the moment the attitude is yes. If we did not have what I believe from my experience in other countries is an unusually good mechanism for assessing quality and being sensitive to need, need in terms of society, if we had not got this set up in a better model than I have seen in any other country I would say that we should interfere, but I think that there is general agreement in the scientific community that we have got something extraordinarily good. So I do believe that the global amount of money is the only thing which really needs to be decided.

Senator Grosart: Could I just go beyond that: If this is so, would it seem to follow that the decision as to the total amount of public moneys that are voted to R & D should also be the end of the political decision? That it should not, for example, attempt to say of the total Government funding of R & D what amount should go to basic research, what should go to applied research, and how much go to development? Would you say, in other words, that the political decision-maker has two decisions: One, the total amount; two, its allocation between claims?

Dr. McGregor: Again, yes, I think that is an extremely good question. The machinery for distributing optimally the money for R is already set up. There is not a good national decision-making body that I am aware of that decides how much to R and how much to D. I am not sure just how that could be done.

Senator Grosart: Are you speaking now of medical research?

Dr. McGregor: Biological medicine, yes, certainly. The second question that was raised just before that was could the MRC do its job better? We have heard that there is not enough support for start-up schools. The MRC already has programs specifically designed for start-up projects which assist in different terms. The only catch is it has not got the money to award to start-up projects that it feels should be awarded. Again, we have heard that departmental chairmen or universities should have a sort of basic amount of money that they are sure of, that they do not even have to compete for every year. I think this is true; I think this money is ideally and should be supplied by the universities. The catch here is that most university allocations are largely geared to a teaching role. There is no specific technique for receiving research strength.

Senator Grosart: We would not agree with that on the evidence we have.

Dr. McGregor: So it is not optimal. The catch is that the university that is unusually able to attract a nucleus of high quality research can attract research grants, can develop a very large budget in relation to the cost of the work being done, but this, of course, costs the university more and more. You rapidly get to a point where a university that has the largest research budget becomes the poorest. This is the specific reason why the United States granting agencies say they will not impoverish a university in this way but will allocate a sum directly to the university, which is a varying proportion, but the average sort of figure is around 40 per cent to 45 per cent from national institutes of health at the moment. That goes straight to the university. That could provide for a few years. the necessary grant for capital for building, for capital expansion, for the small piece of secure ground to which Dr. Ritchie was referring, and it would be geared by our peers in research to where research is going.

Dr. C. H. Hollenberg, President, Canadian Society for Clinical Investigation: There is another role the MRC might consider playing, and that is in spotting areas of scientific scrutiny which are under-represented. At the MRC level scientists of repute across the country could get together and through the scrutiny of applications get a kind of bird's eye view of the type of research being done in Canada. It is at that level that they are apt to pick up broad areas of research that are either under-represented or not represented

at all in this country, and this is reflected in the education our medical students are getting and the care that our patients receive. The MRC might have a valuable role in this regard, in pointing out certain areas of research which are under-represented. This is indeed reflected in the quality of the education being received or the quantity of the applications being received.

Senator Grosart: I think I asked Dr. Brown this question once before. Does the MRC fund only in response to requests or do you initiate projects or programs by funding?

Dr. Brown: The vast bulk of the money is in response to requests, which are not initiated in any way by us. Some small part is spent on projects submitted, which have been stimulated and almost planned by us. No research is carried out by us.

Senator Grosart: Is it possible to develop a viable overall policy for medical research merely on the basis of response, or largely on the basis of response?

Dr. Brown: No, sir.

The Chairman: It would be possible if you believed in the law of the private markets in business, but you do not and I do not.

Senator Grosart: I never believed it was there, because I spent most of my life creating demand.

The Chairman: The market.

Dr. Cinader: I would like to say that to advocate a group format is a much more extensive way in which additional funding could be carried out. We felt this would provide the MRC with a tool through which it could locate areas where strengthening is required and would have a ready made weapon by which this strengthening could be carried through.

The Chairman: Dr. Brown, do you have the power at the moment to use this other approach and go to people and say, "Well, we think there is a gap here and we would be prepared to help you if you were prepared to undertake this project"? Is it a fact that you have not gone into this too often and too systematically due to lack of funds?

Dr. Brown: It is due in large measure to lack of funds. I should like, if I may, Mr. Chairman, to refer to the important point Senator Grosart raised about decisions which

might best be made at different levels of government. He spoke about one simple decision—a global decision—that might be made at the political level regarding the support of R and D. I should think that he was testing out an idea.

The Chairman: It was a sleeper.

Senator Grosart: I had my supplementary ready.

Dr. Brown: Decisions at the political level must be considered, of course, in the light of what the community wants. The social objectives at the time must be defined, and the contribution science can make must be determined. A decision has to be made within science, but the contribution can be made by additional research. When one passes that level, I think, as you have suggested, it becomes a matter for the scientists to administer. This is their area of expertise.

Senator Grosart: If you have the limitation of the political function at the global level the first obvious question would be, what about the departments of Government? All the way down one must make political decisions affecting research and development, so that the unique global limitation just would not work under our system unless we changed the whole system.

The Chairman: Not tonight.

Senator Robichaud: Mr. Chairman, as it is very late and we know we have to meet tomorrow morning my questions will be brief, and I hope they will require brief answers.

The brief from the Royal College of Physicians and Surgeons recommends that there should be provision for a wide consultation by Government on scientific policies and it also adds that the Royal College would be anxious to have representation on any consultative body established. May I ask Dr. Turcot if the Royal College is now represented on the Medical Research Council?

Dr. Turcot: Members of the College do participate in the Research Council, but not as representatives of the Royal College. That is not what was meant by this, though.

Senator Robichaud: In relation to such consultation, the suggestion has been made earlier today by witnesses, that there should be a continuation of this committee, so that in the future it could act more or less as a

liaison between different scientist organizations in Canada and the Government. In other words, it would provide a channel for a follow-up of the valuable information which has been put forward before this Committee. Could we have your brief comments on this suggestion?

Dr. Turcot: By what has been said tonight, I guess we all learned a lot about each other, so a committee of this kind, in a sense, is valuable.

The Chairman: I am sure that Dr. Turcot would be prepared to have official representation from his body on this committee, but in order to have such official representation he would have to go to the other chamber first.

Dr. Turcot: I guess that if an organization is set up to study all these things in depth, we would like to participate.

Senator Robichaud: As such? As the Royal College, as the organization?

Senator Yuzyk: On behalf of all the physicians and surgeons?

Dr. Turcot: On the point that we are involving education very closely and in contact with research.

The Chairman: Although it is very late I would like to raise what is, as far as I am concerned, a final question. I have heard all kinds of compliments paid by all people to the Medical Research Council but I have heard some criticism, in private, about the system of grants which is being conducted by the Department of Health and Welfare. I wonder if we could have some of these criticisms made in public. I understand that there are some problems there and I wonder what was exactly the problem which was causing anxiety or criticism.

Dr. Wigle: Perhaps you could make it in a positive sense, directed towards the MRC, that it is on the basis of the excellence of the peer system of judgment, that the MRC is looked upon as being a good agency. If I were looking at this, I would say that it is the peer system of the most respected scientists in their field on the MRC.

The Chairman: Do you mean that in the Department of National Health and Welfare they do not use that system in the allocation of their grants?

Dr. Wigle: I do not know the details, but I have heard, obliquely, as you have, and I

would prefer to put it in on the more positive basis of what I know to be the basis of excellence being the criterion. If what you are saying is that the Department of Health and Welfare has not that basis, then I would think this might be the point.

The Chairman: I think you should be in politics.

Senator Yuzyk: It may be they need more peers.

Senator Grosart: Maybe they need more peers.

Dr. Wigle: Mr. Chairman, I think this just points out that DH and W are dealing in an area of research that is fully developed in Canada. In the province of Ontario they had a certain amount of money to devote to research and the delivery of health care. They could not award all the money they had because the applications did not justify awarding of the money.

I think this points out, as Dr. Evans was mentioning earlier, that this is an area of operational research that we are lacking in this country and it has to be encouraged.

Dr. Copp: Mr. Chairman, one other great advantage of the Medical Research Council is the flexibility in the use of research funds and in accounting.

The Chairman: Do you have a more complex system of accounting in the Department of Health and Welfare?

Dr. Copp: Fantastically so. You cannot change the size of your test tube from one size to another size without getting the approval from Ottawa in the case of DH and W. That is perhaps an exaggeration. But the Medical Research Council makes grants to individuals and then they are free to use their own judgment in the way in which the funds are expended, in general.

Dr. Wigle: Mr. Chairman, we have heard tonight the difficulty in funding the grants applications for the new investigator. We have heard MRC this year can only grant one third of applications that are made. The provinces are involved here. We have heard repeatedly tonight that it is important to have people doing research in the medical schools, and the provinces are involved because they have medical schools and there is medical education involved, and the research is

important to education in that we have the installation in students' minds of the inquisitive investigator's approach to things.

I think that there are two provinces in this country—I am not sure whether your committee is concerned at all with science at the provincial level, but there are two provinces in this country that do have provincial research councils. They are serving a useful function in this capacity of granting funds for the new investigator, because then they can become established, and once they become established then they are prepared to go and be judged by the national standards of excel-

lence that the Medical Research Council has established.

It is very difficult for them to be judged by these standards when really they are just starting. I think there is a role here for the provinces to play in the establishment of new investigators.

The Chairman: Thank you. I am sure I speak on behalf of the committee when I say we have enjoyed our evening with you tonight. We hope to meet you again at some future time.

The committee adjourned.

APPENDIX 104

BRIEF
TO THE
SPECIAL COMMITTEE OF THE SENATE ON SCIENTIFIC POLICY
SUBMITTED BY
THE ROYAL COLLEGE OF PHYSICIANS AND SURGEONS OF CANADA

OTTAWA

March 26, 1969

JACQUES TURCOT, F.R.C.S.(C)
President
JAMES H. GRAHAM, F.R.C.P.(C)
Secretary

BRIEF TO THE SPECIAL COMMITTEE OF THE SENATE ON SCIENTIFIC POLICY

Submitted by: The Royal College of Physicians and Surgeons of Canada

SUMMARY AND RECOMMENDATIONS

1. The Royal College of Physicians and Surgeons of Canada is a national body established by a special Act of Incorporation of the Parliament of Canada. It provides standards for the training and recognition of medical and surgical specialists in Canada.

2. Royal College qualifications are available in clinical specialties and the branches of laboratory medicine, with special provision being made for career medical scientists.

3. The Royal College training regulations encourage high quality clinical and basic science training.

4. The Royal College provides some modest incentive to investigative work in its annual competitions for the Royal College medals for original work in medicine and in surgery. The College Journal, the Annals, includes some scientific material.

5. Automation of College administrative function now under way will increase greatly the potential for research related to the College's specialty qualifying function.

6. The establishment and development of the Royal College's R.S. McLaughlin Examination and Research Centre will modernize and improve Royal College examinations and provide an agency for research relating to the whole examining process.

7. The Royal College stresses the importance of increased governmental financial support for medical research in Canada to meet more adequately the known urgent needs.

8. Provision for wide consultation by government on scientific policy is recommended. The Royal College would be anxious to have representation on any consultative body established.

PART I - HISTORY AND FUNCTIONS OF THE ROYAL COLLEGE OF PHYSICIANS AND
SURGEONS OF CANADA

I.1 The Royal College of Physicians and Surgeons of Canada was incorporated by special Act of the Parliament of Canada in 1929. The intention was to establish in Canada a body to provide graduate qualifications signifying training and competence in special branches of medicine or surgery, qualifications previously unavailable in Canada. The interests of the Royal College are educational, in particular, the field of graduate medical education.

I.2 The Royal College offers Fellowship examinations currently in fourteen medical and nine surgical specialties. There are now 4,389 Fellows of the College, over 94 percent of whom are resident in Canada.

I.3 The prestige of the Royal College Fellowship ranks high in university and hospital centres in Canada and throughout the British Commonwealth and elsewhere. In many teaching hospitals in Canada the Fellowship of the Canadian Royal College is a requirement for an appointment to the hospital staff. The standards created by the Royal College in its Fellowship programme have assisted in the development of a core of clinical teachers in the Canadian medical schools and have promoted a high quality of specialty practice throughout the country.

I.4 In addition to the Fellowship degree, the Royal College has offered over the past 25 years specialist certificates in the approved medical and surgical specialties. These specialist certificates are obtained by examination and are intended to indicate that the possessor has had a satisfactory training and has acceptable proficiency in his specialty. The Certification examinations are of a somewhat lesser standard than the Fellowship examination in that they do not demand such breadth of knowledge of general medicine and/or surgery, or such depth of knowledge of basic sciences. Currently specialist certificates

are held by 13,207 physicians and surgeons in Canada. This figure includes the Fellows of the College to whom the appropriate specialist certificate is granted automatically. The number of specialties in which Certification examinations are conducted is somewhat less than for Fellowship. Under the present Act of Incorporation, provision is practical for affiliation of certificated specialists with the College but not for admission to full membership in the College.

I,5 In pursuing its educational activities the Royal College is concerned with:

a) Establishment of Standards of Graduate Training

Graduate training programmes in 24 approved specialties have been prescribed. The usual programme is of four years' duration beyond the internship and is identical for both Fellowship and Certification examinations where both are conducted. Applications for the examinations are scrutinized for fulfilment of all of the requirements for eligibility.

b) Approval of Hospitals for Graduate Training

Since 1947 the Royal College has conducted a programme of approval of hospitals in Canada for graduate training in an effort to assure that training taken by candidates in preparation for the Royal College examinations would be undertaken in appointments providing a satisfactory educational experience. At the present time 150 hospitals in Canada have varying degrees of approval by the Royal College for graduate training in medical and surgical specialties and provide about 3,500 training posts. Approximately two-thirds of the hospitals are affiliated with a university medical school.

c) Conducting Examinations

The Fellowship and Certification examinations are held once each year and may be taken in either the French or English language. The examinations consist of a written portion and oral and practical portion. More than 300 examiners are required and they are largely senior members of Canadian university medical schools. In 1968 there were 1,328 candidates approved for the Fellowship examinations and 1,084 candidates approved for the Certification examinations.

d) Participation in Continuing Medical Education

The Royal College holds an Annual Scientific Meeting of three days which is open to both Fellows and Certificated Specialists. In addition two Regional Meetings are held annually which are open to all medical practitioners. The Royal College Educational Endowment Fund provides a revenue which is expended wholly in educational objectives. The Library is devoted to historical volumes and documents.

1.6 The Royal College Council and Officers have been largely senior academic persons from Canadian medical faculties. Formal liaison between the Royal College and the Canadian medical schools has been improved in recent years through the Association of Canadian Medical Colleges, an affiliate of the Association of Universities and Colleges of Canada. In developing qualifications in the medical and surgical specialties in Canada, the Royal College consults also with the national voluntary societies which have been established by most of these specialties. The Royal College is thus in a position to act in an intermediary capacity concerning the academic and the practical aspects of specialty qualification and practice in Canada.

1.7 In Canada each province has the prerogative of establishing the legal manner in which medical specialists will be recognized within its jurisdiction. Royal College qualifications have been widely used by the provinces as criteria for this purpose. The College of Physicians and Surgeons of Quebec, the statutory licensing authority in Quebec conducts a programme of certification of specialists for that province; a cordial and co-operative relationship exists between the Quebec College and The Royal College of Physicians and Surgeons of Canada.

PART II - POLICIES AND ACTIVITIES RELATING TO RESEARCH
AND MEDICAL SCIENCE

1. The Royal College is not directly active in medical research. However, its graduate training requirements encourage graduate students in training for the medical or surgical specialties to spend one or more years in research or clinical investigation in order to acquire a critical and analytical approach to clinical problems, and become thoroughly acquainted with the specialized techniques which are essential to the practice of their chosen specialties. Since many trainees are interested primarily in the practical clinical application of their specialty and are not necessarily suited to research training, such training is not mandatory under Royal College regulations.

2. Questioning in basic sciences constitutes a major portion of the examinations in all specialty examinations of the Royal College.

3. The Royal College believes that the basic research carried out in the pre-clinical departments of a medical school and the clinical investigation which is done in the teaching hospitals both contribute to the scientific basis of medical practice. Increasing research activities in these areas create an

atmosphere of scientific curiosity and critical enquiry which extends to the teaching programmes in undergraduate and graduate education. The Royal College has welcomed the establishment of the Health Resources Fund and increased financial support for the Medical Research Council as steps which will further improve medical research and benefit undergraduate and graduate teaching.

4. The Royal College in the past has expressed its support for the recommendations of detailed analyses of the requirements for adequate financial support for medical research in Canada such as the "Gundy Report" of 1965. We wish to again stress the importance of increased governmental financial support for medical research in Canada to more adequately meet the urgent needs that have been demonstrated and described.

5. Royal College qualifications are offered not only in clinical fields but in branches of laboratory medicine. The science of pathology is concerned with the causes, development, nature and behaviour of disease, and the practice of laboratory medicine is the application of this scientific knowledge to the care of patients. For many years specialty qualifications in this broad field were offered only in General Pathology and Medical Microbiology, but recently qualifications have been made available also in four additional sub-divisions, namely, Anatomical Pathology (morphological aspects of disease), Medical Biochemistry (chemical aspects of disease), Haematological Pathology (laboratory aspects of diseases of the blood and blood-forming organs), and Neuropathology (pathology of diseases of the neurological system).

6. Royal College training regulations and qualifications have been designed primarily for clinical specialists and practising laboratory

specialists. However, some medical graduates enter almost immediately into a career in medical science devoted wholly to basic or clinical research. To provide an avenue for entry into the Royal College for such persons, the Royal College Council in 1964 established special examination regulations for career medical scientists. A number of medical scientists have been admitted to Fellowship in the College under these special regulations.

7. The Royal College offers for annual competition "The Royal College of Physicians of Canada Medal" and "The Royal College of Surgeons of Canada Medal". The medals are awarded for original scientific work judged best in the College's Division of Medicine and Division of Surgery. The purpose of the awards is to stimulate original work by young clinicians and investigators. In addition to the medal, each award winner receives a cash prize of five hundred dollars, and their scientific work is presented at the College's Annual Meeting.

8. The Royal College publishes a quarterly journal, "The Annals of The Royal College of Physicians and Surgeons of Canada". While at the present time this is intended principally as a means of communication with the Fellows and certificated specialists, the journal has some scientific component derived from the major scientific presentations at the College's Annual Meeting and it also includes the abstracts of the scientific papers for that meeting.

9. The Royal College is currently engaged in the gradual implementation of automated techniques in its administrative procedures. As this system is completed it is anticipated that the College can produce research studies relating to candidates for its examinations, the training programmes and training areas, the examinations, the supply and distribution of specialists in Canada, and many other related and inter-related studies.

10. The most important Royal College function is the conduct of its

examinations. Research in testing and examining techniques in recent years has emphasized the development of objective methods of examining which might be free from the variations possible in the subjective assessment inherent in traditional techniques of examining. Early and limited utilization of objective methods in Royal College examinations has been favourable. In 1968 the Royal College was the recipient of a substantial financial grant from the R.Samuel McLaughlin Foundation to support the development of an Examination and Research Centre. The work of that centre is now well under way under the direction of Dr. D.R. Wilson, Professor and Head of the Department of Medicine at the University of Alberta. It is anticipated that this unit, established under Royal College auspices but currently based at the University of Alberta will make a very substantial contribution to the development of improved examination methods not only for the Royal College but all Canadian medicine. To promote the expeditious development of the work of this centre to modernize and improve the Royal College examinations the Council of the Royal College has indicated its intention of providing additional financial support for the development of the R.S. McLaughlin Examination and Research Centre to supplement the funds pledged by the McLaughlin Foundation for the five-year period 1968 to 1972.

11. It is recognized that there has developed a body of knowledge, a sort of "science" in itself, as to how scientific research should be supported and developed, how priorities should be established, and other related matters. It is recognized, too, that there has been established a "Science Council". It is recommended that in addition, consideration be given to provision for wider consultation in determining scientific policy. If a body of a consultative nature such as this should be established, the Royal College would be anxious to have representation.

APPENDIX 105

ASSOCIATION OF CANADIAN MEDICAL COLLEGES
ASSOCIATION DES FACULTES DE MEDECINE DU CANADA

A BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF
THE SENATE OF CANADA

OTTAWA

1969

Special Committee

BRIEF TO SENATE COMMITTEE ON SCIENCE POLICYFROMTHE ASSOCIATION OF CANADIAN MEDICAL COLLEGES/
L'ASSOCIATION DES FACULTÉS DE MEDECINE DU CANADA

The Association of Canadian Medical Colleges wishes to present to the Senate Committee on Science Policy its views on several critical issues in science policy which have a direct bearing on the welfare of medical education and medical research in Canadian universities. It would welcome the opportunity of defending its views if, in the opinion of the Committee, this was considered desirable and possible.

THE CASE FOR A STRONG FEDERAL AGENCY FOR THE SUPPORT OF MEDICAL RESEARCH

The recognition of scientific merit is the most critical task of any agency charged with the development of science. No provincial body could achieve this as effectively as a federal agency such as the Medical Research Council which draws on the scientific personnel of the entire nation in carrying out this task.

The role of the Medical Research Council in stimulating the training of scientists and teachers at Canadian universities is an important federal contribution to the creation of a manpower resource which is essential to the prosperity of medical science and education in Canada and which is not confined by provincial boundaries.

It may be tempting in the cause of regional development or provincial autonomy to direct funds in support of scientific development into cost shared programs such as the Federal-Provincial Grants. The danger of lack of development or of

progressive disparities between the provinces must be recognized as a danger of programs which are dependent on provincial or regional initiative. Furthermore, it must be conceded that the provinces already have a major financial burden in relation to the development of the health sciences by virtue of their responsibility for establishing and supporting educational institutions and hospitals at a level which will encourage the necessary basic and applied medical research programs.

RECOMMENDATION

Since in our opinion a federal agency such as the Medical Research Council as presently constituted is a uniquely effective mechanism for the stimulation and growth of medical science in Canada, it is recommended that no change in federal policy should be made which would weaken or interfere with its function.

FINANCIAL SUPPORT OF MEDICAL RESEARCH IN CANADA

Programs of medical education and of medical science are expanding rapidly with the support of the federal Health Resources Fund to meet needs identified by the Royal Commission on Health Services. It would be ironical and damaging for the federal government to withhold the financial support necessary to establish and maintain a reasonable level of scientific research in these new facilities. We are concerned that an inadequate rate of expansion of funds available to the Medical Research Council for support of scientific research will interfere with the recruitment and maintenance of academic staff at the universities and indirectly affect the quality of educational programs for the health professions

as well as reducing the likelihood of early application of scientific advances to the delivery of health care.

Report No. 4 of the Science Council of Canada has stressed the importance of applied research in many areas including health. The federal government has the opportunity and obligation to lead in the development of better quality and distribution of health resources and in the evolution of a better system of health care. Since applied operational and developmental research are among the most expensive types of medical research, it is possible that in a period of financial constraint funds might not be made available to meet this important objective or that this objective would be met at the expense of existing programs of more fundamental research. It is our opinion that it is only from a sound platform of basic research activity that these endeavours in applied research will be successfully launched. We believe that the total investment in medical science in Canada is very modest by any yardstick of comparison and that a balanced program of fundamental and applied research will only be achieved by a significant expansion of financial support for applied research which is not achieved at the expense of continuing growth of more fundamental scientific programs.

In view of the central role which faculties of medicine and university health science centres are now beginning to serve in organizing and evaluating the system of delivery of health care on a regional basis, it is important that increased financial support for operational research be made available to university centres in a manner which will have an immediate, specific and substantial impact on the quality, quantity and distribution of health care.

Over the past five years there have been substantial fluctuations in the rate of increment of funds available to the Medical Research Council for its scientific programs and in the interpretation of policy governing capital assistance from the Health Resources Fund. The fortunes of medical research in Canada have gyrated with these fluctuations. In the interests of sound, long-range planning of scientific programs, development of facilities and recruitment and training of staff, it is important to have a clearly defined policy of financial support which is predictable on longer than a year-to-year basis.

RECOMMENDATION

A substantial expansion of federal financial support of medical science is required to keep pace with the growth of health sciences education, stimulated by the Health Resources Fund in response to needs identified by the Royal Commission on Health Services. A predictable, longer range policy on financial support is necessary to permit rational planning and to develop the most advantageous balance in the commitment of available resources to fundamental, applied, operational and developmental research.

OVERHEAD COSTS OF MEDICAL RESEARCH

Grants from the Medical Research Council to support scientific research are not accompanied by an allowance to cover the overhead costs of sustaining the scientific endeavour in the institution where the work is carried out. Scientific centres of excellence are certainly not created by funding alone. They tend to occur as

a result of a combination of more subtle factors, one of the most important of which is the aggregation of a critical mass of scientists of high calibre in one location. The more successful an institution is in achieving this result, the greater the financial strain it experiences. In the U.S.A. for every dollar awarded by the National Institutes of Health to support extramural scientific endeavour, the institution receives an additional sum varying from 15-50 cents to defray the overhead costs associated with the research.

RECOMMENDATION

That the Federal Government institute a policy to defray reasonable overhead costs associated with scientific research supported by the Medical Research Council in universities.

ROLE OF THE A.C.M.C. IN CANADIAN MEDICAL SCIENCE

The Association of Canadian Medical Colleges was originally set up by the deans of Canadian medical schools to co-ordinate their efforts in relation to common problems of medical education. In the absence of other national mechanisms the Association has started to fulfil several needs which are clearly of national importance in relation to science. These include projections of needs for health manpower, cost studies of the operation of medical schools and teaching hospitals, a data bank of medical school applicants, etc. The A.C.M.C. is regularly consulted by the universities, Department of National Health and Welfare, foreign governments and other bodies to supply information which is of a national character. It is doubtful whether the A.C.M.C. will be in a position to continue to play this role of national importance

if its financial needs are met only by contributions from the individual universities supplemented by unpredictable short term grants-in-aid from American foundations.

RECOMMENDATION

Unless the Federal Government intends to set up an alternate method of collecting and collating information of the type now handled by the Association of Canadian Medical Colleges, the national role of this Association should be recognized by solid long-term federal funding.

ACMC/AFMC

May 20, 1969

APPENDIX 106

A BRIEF TO THE SENATE COMMITTEE ON SCIENCE POLICY

By: B. Cinader, President of the Canadian Society
for Immunology,
Head of the Subdivision of Immunochemistry,
Ontario Cancer Institute,
Professor in the Department of Medical
Biophysics,
University of Toronto,

and A.C. Wardlaw, Professor in the Department of Microbiology,
University of Toronto.

INTRODUCTION

1. Canada has a unique opportunity for shaping its future during the rest of the twentieth century; neither densely populated Europe nor the U.S.A. has this same potential. The utilization of the territory of European nations has occurred at the time of the industrial revolution; thus land utilization and population-distribution is determined by the technology of earlier periods. Only Canada, and possibly Australia, could create a Society in terms of the cultural implications of science, and of the technology of the twentieth century. The unique contribution of Canada should therefore rest in provision for the future and hence in a major stress on long-term objectives.
2. We have little prospect of becoming competitive with the U.S.A. in exploitation of known principles of biology. It is in planning to foster creativity and originality that we may hope to do so.
3. Any forward-looking science policy requires three elements:
 - 1) a vision of the future which allows the identification of short-range and of long-range objectives.
 - 2) a knowledge of existing facilities in intellectual and material potential.
 - 3) an evaluation of the extent to which the existing facilities measure up to the objectives.
4. Categories such as fundamental and applied research, injected into analyses of this kind, obscure the practical potential of research into basic processes and its role as a pacemaker of social change. Thus it is the time-scale of objectives (immediate or long-range) which has operational significance. It is the so called "fundamental" research which permits major practical advances.

5. Science policy must be seen not only in relation to the products of research, but also in relation to the educational role of research, and in terms of its cultural influence on society as a whole. Quality of research and of higher education are interdependent.

1) Effective teachers are those involved in the evolution of the subjects they teach.

2) Teachers are trained largely through research participation as graduate students.

3) Good men will not accept teaching posts unless good research climate and facilities go with them.

4) The brightest students will not elect academic careers unless stimulated by the interest and excitement of productive research programmes.

5) Students should be trained in research-oriented environments in order to equip them with the critical faculties which they will need to adapt to a rapidly and continuously changing society and to evaluate new ideas, new products and new procedures.

6) Objectives of long range planning in relation to science policy depend on trained people.

SUMMARY

6. In medicine and biology, some long-range objectives for the betterment of mankind depend on advances in neurobiology (the biology and biochemistry of mental processes), human genetics, gerontology (the study of the biology of aging) and immunology. This submission to the senate deals with the fourth of these prongs of advance.

7. There is little doubt that both the short-range and long-range objectives of any reasonable policy towards advancement in medicine require

an adequate balance between research into the cellular and molecular mechanisms of the immune response and the application of the resulting findings to practical medicine. The application of fundamental discoveries in immunology to every-day practice has progressed swiftly during the last two decades, and the prevention of such immunological diseases as haemolytic disease of the newborn ("Rh-negative babies") may be quoted in this context. At the same time, a number of areas can be pointed to in which applications of immunology is in its infancy.

8. Transplantation of organs of the human body clearly ushers in a revolution in modern surgery. At the moment, however, a blunderbuss approach to the problem of controlling the rejection of transplants is being resorted to. It is found necessary either to destroy many dividing cells of the body or to destroy a large proportion of the immune apparatus in order to control rejection of a transplanted organ. It is quite clear that a much more specific inhibition of the immune response must be a future target of therapy.

9. Atopic disease (such as asthma) presents another area in which an undesirable immune response leads to disease. The current approach has become conventionalized: it relies almost exclusively on inhibition or antagonism of the effect of chemical mediators of the undesirable immune response, or on immunization with allergens in an attempt to supplement an undesirable antibody (γE) by one that is not harmful. A survey is needed of methods which would allow the selective suppression of the synthesis of disease-inducing classes of antibodies.

10. We need to determine the role of autoantibodies, which are only rarely disease-vectors, and in some cases, may even play a protective role in inhibiting cellular autoimmunity. Certain autoimmune diseases

may represent yet a third target for which it might become necessary to devise means by which the synthesis of antibodies can be prevented. In this context, it might become desirable to learn how to regulate the formation of antibodies of a particular kind of specificity.

11. We could multiply examples and discuss, among others, immunotherapy of cancer as an area which should be fostered. However, enough has been said to support our contention that frontiers of future medical practice are to be found in many fields of immunological research.
12. If one examines the above practical objectives, one finds that all of them depend on detailed knowledge of the regulation of the immune apparatus: we need to learn how antibodies of different specificities and of different classes are synthesized and how this synthesis can be interrupted or augmented. This is one of the principal targets of the long-range objectives of contemporary immunology. Any forward-looking medical school would have to plan for conditions which create a climate in which basic work of this type can flourish, and in which clinical departments take a hand in the application of newly acquired knowledge. It will become evident in the following pages that only a few medical schools have given thought to this aim. Not all medical schools are defining their research-role as a task of pioneering the procurement of scientific information and its speedy translation into clinical trials.
13. We have so far stressed central issues in which the long-range and short-range objectives of immunological research are closely related. We have done so because some aspects of these problems must be relevant to the research targets of every medical school. In addition, there are objectives which could be approached directly with knowledge and techniques which are already available. This may be exemplified by the problem of infertility

and birth control - which are but two aspects of the same - problem and which impinge on the happiness of some individuals and also on the survival of mankind. Immune processes may be involved in some cases of infertility and may have a major role to play in future approaches to population control. We find little evidence that this or any one of a host of definable problems, such as gerontological aspects of the immune response, has been regarded as an area of research-specialization by any medical school.

14. Recent developments in the role of granting agencies have been favourable to the development of fundamental and clinical aspects of immunology. The Medical Research Council has set up a grant committee, dealing with immunology and transplantation, and has taken the initiative in the organization of nation-wide clinical trials. At present, a test of the effectiveness of antilymphocyte sera is underway. The "fall-out" from these endeavours goes far beyond the important practical objectives of transplantation. The trial necessarily involves contract research into methods and side effects and necessitates the diffusion of new immunological techniques into service laboratories right across the country. At the "grass roots" level, the final outcome of these activities will depend on the vision and imagination with which plans are made in the Universities to prepare the ground for creative developments in the future. In this area, there are propitious signs. Some medical schools have become aware of the need for an effective immunological contribution to the solution of the practical problems arising from the revolution in modern surgery, from the need to develop methods capable of dealing with autoimmune disease and from the need for a rational and forward-looking approach to atopic disease and to tumour-immunology. It has become quite clear that isolated immunologists, in departments such as surgery and medicine, would be largely concerned with

empirical applications of presently available knowledge in a service function and might therefore fail to contribute in sufficient depth for effective developments in the future. To avoid this danger, it is necessary to link service units with groups which are primarily concerned with fundamental research. The recognition of this need has motivated at least three Canadian medical schools to consider ways which might provide their pioneering surgeons, internists, dermatologists, obstetricians and allergologists with the "back-pressure" of fundamental research. With this aim in view, one medical school (University of Manitoba) has founded a Department of Immunology and two others have advanced to preliminary administrative measures (Alberta and Sherbrooke). In advocating the establishment of Departments of Immunology there is no thought of taking over or directing work on immunology in other departments. On the contrary, a Department of Immunology, engaged in active research and from which guidance and counsel could be sought, would serve as a stimulus to independent immunological research in whatever branch of science. Several European countries have led the way in this new development. The Universities of Freiburg, Copenhagen, London, Milan and Birmingham are among those who have set up independent Departments of Immunology, and, already, the fruits of these ventures have proven their value.

15. The aims of immunology have so far been examined in terms of the long-range and short-range objectives of modern medicine. Immunology has, however, other very exciting aspects which should entice science faculties to promote investigative work.
16. At the heart of all biological studies must lie the question of the evolution of biochemical processes. This contention is partly motivated by a profound need to understand man's origin and partly by the growing need to manipulate our environment.

17. If one examines the biochemical processes, from micro-organisms to higher animals, one finds an extraordinary conformity of biochemical mechanisms. This is exemplified by the universality of the genetic code and of intermediary metabolism. Indeed, one might well generalize and say that the main advances that have occurred in evolution during the last six hundred million years lie in the complexity of organization rather than in the acquisition of new biochemical apparatus. One of the few exceptions to this general statement lies in the acquisition of the ability to make antibody to an enormous range of different foreign substances. It is clear that this process must have developed gradually and that its study may well serve as an instructive guide-line by which refinements in our knowledge of evolutionary processes can be acquired. This is a "philosophical" inducement for research; there is also an important practical one. Our civilization has increasingly encroached on the conditions for the survival of many mammals, fishes and birds. The population of many species is being progressively reduced and epidemics are thus a great potential danger to the survival of some species. It may be important to develop strains of animals which are resistant to disease and to examine, in this context, the genetics of the capacity to make a vigorous immune response. Thus, fundamental studies of the inheritance of the specific immune response and breeding experiments with selected wild and domesticated species are indicated.
18. At the same time, a search for inherited defects and their analysis would help to determine the steps in cellular differentiation and interaction which results in the productive immune response. This might also lead to the discovery of regulatory substances which may be required in this process.

19. Immunochemistry has provided tools, for the enumeration of macromolecules and for the inhibition of biological activity. This approach deserves extensive further development; existing knowledge should find a place in the training of biochemists, biologists and chemists as well as in the training of chemical engineers and veterinary and medical researchers. It is surprising to find how little immunological research is being carried out in Canadian Departments of Biology. It is equally remarkable that no provisions are made for adequate training towards postgraduate qualifications in immunology. A strengthening in this area is as badly needed as is strengthening and integration of the dispersed immunological research in medical schools.
20. Recommendations of this panel include: the foundation of Departments of Immunology in medical and graduate schools; the recruitment of outstanding investigators in immunology; encouragement of young and original workers by extensive long-range support; and provisions for specialized graduate training and research in Faculties of Arts and Sciences as well as in Faculties of Agriculture.
21. In order to make recommendations for the future, we have attempted to survey the current state and directions of immunological research in Canada, using information obtained from the Medical Research Council and other granting agencies, and from questionnaires sent to immunologists and persons working in related fields.
22. The following pages will present our findings. The challenge sketched in the foregoing pages is not met by the existing situation in the majority of our institutions.

SURVEYWhat is immunology?

23. Immunology is a branch of medical science started about ninety years ago with Pasteur's work on vaccination against anthrax and rabies. Around 1900 Landsteiner discovered the human blood groups and Richet uncovered the phenomenon of allergy, or hypersensitivity. These seemingly unconnected events provided the foundation on which modern immunology is built, for they all contain, as a common denominator, the tissue reactions of animals (and man) to foreign cells or substances that enter the body. These tissue reactions which constitute the "immune response", can be beneficial or harmful, as seen respectively in the fields of immunity to infectious diseases and allergy. Cells or substances which provoke the body to make an immune response are called "antigens" and the response that the body makes consists usually in the synthesis of specifically reactive proteins known as antibodies which combine with the antigen and speed up its removal. Among the antigens that have been most extensively studied are a) those on bacteria and viruses because of their importance in vaccines, b) those on the red cells of the blood, because of their importance in blood transfusion, c) antigens of skin, kidney, heart and other organs, because successful surgical transplantation depends on proper immunological matching of donor and recipient, d) environmental antigens such as those in grass pollen, house dust, etc., because of their importance in allergy, e) "self" antigens, that is the components of the body which are involved in autoimmune diseases - literally diseases such as rheumatoid arthritis where, by an aberration of the body's immunological machinery, it makes an immune response against itself. Pervading these diverse aspects is the unifying concept that immunology is centrally concerned with

the nature and activities of antigens and antibodies and with "self" and "not-self" recognition and reaction processes in the tissues of higher animals and man.

24. Immunology has always been the Science in which outstanding fundamental work and revolutionizing practical advances have been closely linked in time and in the outlook of the leading research workers. In the second and third decade of this century, preventive immunological measures led to the effective control of such dread diseases of childhood as diphtheria and in the following decades, whooping cough and poliomyelitis were added to the diseases which could be controlled by routine immunization.

25. In recent years, the principal theoretical advances in immunology have come from studies of antibody structure, of regulation of antibody-response and of the cellular processes which underlie the immune response. From a medical point of view, the second of these approaches have been the most rewarding and remains the most promising; we have already spoken of the successful prevention of hemolytic disease (Rh-babies) and of the continuous progress in transplantation of organs which depends on our ability to regulate the immune response.

26. Biological research with long range objectives has come under attack in many countries, and the demand was made that scientists should concentrate on immediate practical goals. Few groups can show the erroneous nature of such demands more effectively than can immunologists. Their science has contributed immeasurably to the increased health and longevity of man, while pursuing research into a fascinating aspect of biology.

What aspects of immunology are being investigated in Canada?

27. To answer this question we have relied mainly on the lists of research grants from the various grant-giving agencies in Canada. This gives us a

fairly complete picture of what is going on in Universities and in some hospitals but it does not fully report immunological research done in government laboratories such as the Laboratory of Hygiene or the National Research Council in Ottawa or various branches of the Canada Department of Agriculture. Nor does it cover the immunological research work done in the pharmaceutical industry or in self-supporting institutes like the Connaught Medical Research Laboratories of the University of Toronto.

28. Immunological research in Canada can be divided up among the following fields (with some overlap):

- a) Allergy, hypersensitivity, autoimmunity, immunopathology, hemolytic disorders.
- b) Immunochemistry, meaning the study of the chemical structure of antigens and antibodies, the molecular reactions between antigens and antibodies, the action of antibodies on biologically active antigens such as enzymes, hormones and toxins; complement.
- c) Transplantation of organs; tissue antigens and tissue typing, antigens of red cells, leucocytes and platelets, immunological tolerance, suppression of the immune response including preventing the rejection of grafts and preventing Rh immunization during pregnancy.
- d) Cellular Immunology: Cells and organs of the body involved in the immune response, localization of antigens in the tissues, origins and development of antibody-producing cells, role of the thymus. The fetus in utero considered as a foreign graft.
- e) Microbial immunology: antigens of bacteria, viruses and protozoa; mechanisms of resistance to infectious diseases; development of vaccines and antisera.

- f) Cancer immunology: antigens of tumour cells; possibilities of immunological therapy of tumours.

29. We have summarized main areas in which research in immunology is now in progress. Applications in some areas seem to be in their infancy. This applies to immunological studies with dental applications; only two investigators in Canada seemed interested in this type of study. Since most oral diseases are "chronic inflammatory or destructive" it would appear that immunological investigation may well be relevant to the future development of dental practice.
30. We have found little evidence of the use of immunological techniques in biological industries, such as those concerned with fermentation. Immunological methods for the analysis of macromolecular composition have much to offer in product-development and ways should be found to teach such techniques at the appropriate educational levels.
31. We have attempted to quantitate and tabulate in Table 1 the numbers of individual research projects in these different categories using information from the reports of the Medical Research Council (MRC), Public Health Research Grants (PH), National Cancer Institute (NCI), Canadian Arthritis and Rheumatism Society (CARS), the Defence Research Board (DRB) and the Banting Research Foundation (BRF). We consider that the above sources, while not giving a complete picture, for reasons stated above, cover the main mass of immunological research activities in this country.

What are the current applications of immunological research?

32. This can be answered under two headings a) Immediate practical applications and b) Applications of probably long-range benefit to the Life Sciences.

a) An understanding of immunological principles is essential in several areas of human and veterinary medicine such as the control and treatment of infectious diseases, autoimmune diseases, Rh disease of the newborn, allergies, blood transfusion and transplantation of organs. In addition, the immunological typing of red blood cells is of great value in genetics, (red cell antigens are good genetic markers), anthropology, (origins and relationships of the races of mankind), forensic medicines (identification of blood stains etc.). Immunological techniques find application in many areas of bio-medicine since they provide tools of great sensitivity and precision for measuring and identifying biologically active macromolecules, notably proteins. For example, physiologists use various types of radio-immuno assay for detecting incredibly low concentrations of hormones (insulin, parathyroid hormone) in blood.

b) In recent years the phenomenon of the immune response has attracted the attention of workers from several other areas of biology since it constitutes a model system for studying at the cellular and molecular levels some of the contemporary ideas about the differentiation of mammalian cells, the induction and regulation of protein synthesis and the relationship between structure and function of protein molecules. The fruitful exploration of these fundamental areas of vertebrate biology requires the closest collaboration of the biochemist, the immunologist and the cell biologist.

How many immunologists are there in Canada?

33. This question is difficult to answer because of the scattered nature of immunological effort in Canada. Also it depends on how one defines an "immunologist", since there are no Departments of Immunology, as such, in

Canadian Universities and many people doing immunological research could also be classified as biochemists, microbiologists, paediatricians, pathologists, etc. Thus different criteria for selection lead to different numerical estimates.

34. If we count as an "immunologist" any individual receiving a research grant during 1967-68 for an immunological project then we get a list of 105 names (Appendix). However, this only takes account of the project leaders and excludes professional assistants, post-doctoral fellows, technicians and graduate students. It also omits researchers in industry and other self-supporting institutions such as the Connaught Laboratories in Toronto, the Laboratory of Hygiene in Ottawa and the Animal Diseases Research Institute in Hull.
35. Another index is membership of the Canadian Society for Immunology, which has 223 graduate members in Canada (and a few in the U.S.A.). However, many of these are not engaged in research but hold services positions in blood banks or public health laboratories or are medical practitioners. Nevertheless, they are individuals with sufficient interest in immunology to join the society. Of the total of 223, 53 are already counted as grant holder and 170 are not. A third index is membership of the British Society for Immunology and/or the American Association of Immunologists who live in Canada. Since membership of these societies is restricted to individuals with published work in the field of immunology, it is legitimate to include them in our survey. There are 37 persons in this category, most of whom have already been included in the count of grant holders or as members of the Canadian Society for Immunology.
36. We therefore, conclude that a reasonable estimate of the number of research workers in the field of immunology and having the status of project

leader is between 120-150. In addition, there are about 166 graduates, mostly with higher degrees who have some connection or interest in immunology but who do not have project leader status in respect of their immunological activities.

Where do Canadian immunologists work?

37. One of the most striking features of modern immunology is the penetration of its concepts and techniques into other biomedical disciplines. On the one hand this may be taken as an index of the strength or potency of immunology as a discipline and the value of its techniques. On the other hand this fragmentation of the subject can be considered a weakness for it means that no one department provides a "scientific home" for immunology in the universities. In Table 2 we present a breakdown showing that eighteen different types of University Departments - none of them a Department of Immunology - together with hospitals share the 124 projects which are supported by the major granting agencies.
38. The largest number of immunological projects are located in Departments of Microbiology or Bacteriology or Bacteriology and Immunology and this reflects the historical development of immunology as an offshoot of Medical Microbiology. However, Departments of Pathology and Pathological Chemistry, Medicine, Biochemistry and Surgery also have significant numbers of immunological projects.
39. A similar picture indicating the broad dispersal, or fragmentation, of immunology among biomedical departments in universities is provided by the 1968 MRC publication "Canadian Medical Research Survey and Outlook". This survey divided up the whole field of medical research in Canada into 20 sections and it is noteworthy that ongoing immunological research

activities were reported in 14 of the 20 section reports viz: Anatomy, Physiology, Biochemistry, Pathology, Microbiology and Immunology, Genetics, Medicine, Preventive Medicine, Endocrinology, Paediatrics, Surgery, Obstetrics and Gynaecology, Medical Research in Departments of the Federal Government and Pharmaceutical Industry.

40. We shall turn briefly to the special problems of immunologists outside the Universities. Immunological units exist in such organizations as the Blood Transfusion Service of the Canadian Red Cross, Hospital-centres and various Departments of the Federal and Provincial Governments. The majority of these units tend to concentrate on the application of basic techniques to current problems of immediate medical and veterinary consequence. Despite the routine nature of much of this applied research, it provides information on the distribution of specific pathological conditions and on the efficacy of measures adopted for their eradication. Furthermore, laboratories engaged in this type of investigation often possess a facility for rapid deployment of forces for the solution of urgent ad hoc problems of applied immunology. Unfortunately, it is in this respect that the greatest weaknesses appear to occur: when the value of a project becomes evident, the workers closest to the sources of clinical, epidemiological and epizootological material often encounter difficulty in devoting adequate time and effort to investigation in depth. Such deficiencies stem principally from lack of adequate funds and staff. These deficiencies could be overcome by modest increments in staff and facilities.

What financial support is given to immunological research in Canada?

41. It is not possible to estimate the total financial support given to immunological research in Canada because of the hidden costs such as buildings and their maintenance and the salaries of principal investigators which are usually paid by the University or Institution. Thus, the main

figures we have to work with are the Operating Grants which pay for equipment, supplies and salaries of assistants and some students.

42. In the case of the MRC, the major supporter of immunological research in Canada, a sum of \$1,116,000. went to Operating Grants for immunological research (77 projects) in 1967-68. This sum represents 7.1% of the total MRC Operating Grant Budget of \$15,388,049.

43. The other main granting agencies also give substantial support for immunological research, as follows:

| | |
|------|------------|
| DRB | \$ 22,000. |
| PH | \$431,000. |
| CARS | \$ 62,700. |
| NCI | \$276,700. |
| BRF | \$ 12,360. |

44. Adding up all these sources of funds gives a total of about \$2 million available during 1967-68 in the form of operating grants for immunological research. As emphasized before, this does not include research done in industry, in Government Departments or in self-supporting Institutes, nor does it include capital costs of University buildings and the overhead for heating, lighting etc., janitorial services, secretarial and some technical services. Nor does it include the purchase of major items of equipment.

Through what channels are immunological researchers communicated?

45. The English language journals that are devoted exclusively to the publication of original research in immunology are:

The Journal of Immunology
Immunology
Immunochemistry
International Archives of Allergy
Journal of Allergy

Other journals with a major but not exclusive commitment to immunology are:

The Journal of Experimental Medicine
The Journal of Bacteriology
Folia Microbiologia
Vox sanguinis

46. In addition there are two or three dozen other journals in the biomedical sciences with a 10-30% content of immunological articles.
47. Another index of the importance of current research activities by immunologists is that about 12% of the letters to "Nature", relating to the whole of the biological sciences, deal with immunology.
48. There are no specifically Canadian Journals with a major commitment to immunology although both the Canadian Journal of Biochemistry and the Canadian Journal of Microbiology have Immunological Sections.
49. It is only three years ago that the Canadian Society for Immunology was founded. Already it has a substantial membership, has sponsored two very successful International Symposia and is preparing to sponsor two others. In addition, the Society is beginning to prepare an advanced Summer School in modern methods of immunology. Recently this society joined the Canadian Federation of Biological Societies.

Responses to a questionnaire on the position of immunology in Canada.

50. In order to gather opinions on the current strength, weaknesses and future prospects for immunology in Canada, a questionnaire was sent to:

- A) Deans of all medical schools in Canada
- B) Chairmen of departments in Canadian Medical Schools
- C) Members of the Canadian Society for Immunology

Eighty-nine replies were received, 9 from group A, 40 from B and 40 from C. The Universities from which replies were received were Alberta, British Columbia, Dalhousie, Manitoba, McGill, McMaster, Montreal, Ottawa, Queens, Saskatchewan, Sherbrooke, Toronto and Western Ontario.

51. In general most respondents expressed dissatisfaction with the overall level of teaching and research activities in immunology in Canada. There

are few concrete suggestions on how the situation could be improved, except that over 60% of respondents thought that separate Departments of Immunology should be created in the Universities.

Question 1: "Are the present research activities adequate to provide the fundamental "back pressure" for applications in Surgery, Medicine, Allergy, Pediatrics, in Agricultural research and in Biological Industries?"

Answers: 54 No
 6 Yes
 29 No response

52. In other words, 90% of those who expressed an opinion believed that research activities are inadequate.

Question 2: "Do Canadian Universities at present provide adequate training in modern immunology and/or related disciplines appropriate for careers in the various fields of immunology - Universities, hospitals, government or industry?"

Answers: 48 No
 8 Yes
 33 No response

Question 3: "Is the output of qualified personnel from Canadian universities for work in areas related to immunology adequate? Should this output be increased? If the output were to increase in the coming years, how many positions and at what level of competence, do you think will, or should be, open in your organization over the next 3 - 5 years?"

Answers: 44 stated output was not adequate
 One respondent felt that output was adequate
 Remainder made no reply

 Forecasts of numbers of positions, mainly at Ph.D. level, varied from 1-4, per respondent.

Question 4: "Are the qualifications of personnel at present being recruited from Canadian universities for work on immunological problems satisfactory?"

Answers were very variable. The general opinion was that quality is mostly satisfactory, but well qualified personnel are spread very thin and some units "teeter on the verge of viability". There were 6 unqualified "Noes".

Question 5: "Should the teaching of immunology be continued under the aegis of departments of microbiology, bacteriology, microbiology and immunology, bacteriology and immunology, or should immunology be taught in separate Departments of Immunology with the possibility of offering broad honours courses and major programmes in immunology per se, as distinct from service courses in the medical curriculum"?

Answers: Most respondents to the questionnaires expressed an opinion on this question, some at considerable length. Opinions were very variable although almost everyone stated that immunology should continue to be taught and that teaching should be strengthened and be as coherent as possible.

Answers can be divided into 6 general categories:

- a) Those who favoured a separate Department of Immunology which would act as an academic home for the subject but possibly with cross appointments to staff engaged in immunological research and teaching in other departments: 57 respondents (64%).
- b) Those who believed that creation of a separate Department of Immunology was not justified: 13 respondents.
- c) Those who felt that actual departmental status for immunology was irrelevant or obsolete in a "systems-based" curriculum and that the important thing was the acquisition of personnel of the proper calibre for teaching the subject: 2 respondents.

- d) Those who stated that immunology is intrinsically a multi-focal discipline and should continue to be taught that way: 3 respondents.
- e) Those who thought that the granting of departmental status to immunology could not be determined as a question of principle but should be decided by local conditions prevailing at the particular institution:
7 respondents.
- f) No definite opinion: 7 respondents.

Question 6: "Are there strong centres for teaching and/or research in immunology in Canada? Would it be desirable to consolidate existing centres or establish new ones?"

Answers: There were few very informative replies to the first part although some respondents cited Montreal and Toronto as having strong centres. A majority of respondents thought that additional new centres should be established, rather than strengthening existing ones, and, where an opinion was expressed, that these new centres should be distributed on a more equitable geographical basis, e.g. one in Western Canada.

Question 7: "Are there areas of immunology which are being neglected in Canada?"

Answers: A few "Yes", many "don't know" or no reply, or "not more neglected than many other areas".

Question 8: "Do you believe that research in immunology in your particular sector of activities is being conducted at a level competitive with that in some of the other Western countries, or is it handicapped by lack of

- (i) Supply of trained personnel
- (ii) Sufficient funds for operating grants
- (iii) Major pieces of equipment
- (iv) Information retrieval and other library services".

Answers: Few people answered the first part. Those who did thought that quality was good but that it was spread very thinly, taking the country

as a whole. In regard to factors limiting research --

- (i) Personnel: 28 thought this a limitation
2 thought the position in immunology was barely adequate or no worse than other areas
16 had no specific comment
- (ii) Operating funds: 9 cited this as a limitation
2 thought situation was barely adequate or no worse than other areas
1 stated that his needs were covered
- (iii) Major equipment: 5 thought this was a limitation
2 thought position was "not too bad"
1 thought situation was "reasonably good"
- (iv) Library: only one person asked for better information retrieval facilities, something along the line of MEDIARS in the U.S.A.

53. In summary it seems that lack of personnel was regarded as the major limitation. Lack of sufficient laboratory space was also cited. Lack of operating funds, funds for major equipment or library facilities were not the subjects of many complaints.

Question 9: Asking whether the creation of interdisciplinary research institutes was desirable.

Answers: Almost nobody was wholeheartedly in favour of creating interdisciplinary research institutes except on a very limited scale. Those who did favour such institutes thought they should be university-affiliated. The main objection cited was the problem of what to do with the institute after the departure of the outstanding scientist around whom it was created.

Question 10: "Is it desirable to promote increased collaboration between industrial, academic and government research centers? If so, how might this be achieved, in your opinion?"

Answers: Most respondents felt that increased collaboration was a desirable ideal, but difficult to achieve in practice except in cities where the different spheres of activity were close together. "Cooperation cannot be legislated for" was a typical answer.

Question 11: "Is there a need for more training and for defined service units in Clinical Immunology, Agricultural Immunology and Industrial Immunology?"

Answers: 7 responders thought that there was a need for more clinically-trained immunologists especially to cope with the increasing demand generated by recent advances in transplantation. No one specifically thought there was a deficiency in the other two areas.

Question 12: "Are there other aspects of research in immunology which you feel this questionnaire did not cover and on which you would like to comment?"

Answers: No significant comments.

Forecasts and recommendations

54. Immunology will continue to permeate a wide range of biomedical disciplines to the extent that no serious researcher in these disciplines can nowadays afford to be ignorant of the potential of immunochemical techniques, any more than he can afford to be unformed in biochemistry.
55. Immunological methods and concepts will increasingly be applied in the fields of transplantation, cancer, infectious diseases and autoimmune diseases.
56. The phenomenon of the immune response, together with its product the antibody molecules, will continue to attract the attention of cell biologists, biochemists, biophysicists, geneticists, because of its utility in the study of cell differentiation and the control of protein synthesis in vertebrates.
57. We have already pointed out that long-range objectives in immunology must be formulated by any medical school which realizes its responsibility to contribute to the advancement of medicine. In addition, it must be realized that the widespread use of immunological techniques by people in

many disciplines of biology and medicine, necessitates the presence of local centres of excellence in which training and advice can be given.

58. We do not only need to increase our support for immunologists already in Canada, but also to support immunology by attracting outstanding investigators to our Universities. The foundation of Departments of Immunology, the creation of adequate space for these departments and a climate of good research support, will greatly facilitate this task.
59. Universities should be provided with funds to strengthen existing immunological groups and create Departments of Immunology at least in the major centres. The University of Manitoba has already taken this step and the Universities of Alberta and Sherbrooke have made preparations towards it.
60. Very few existing departments contain a satisfactory "critical mass" of immunologically orientated investigators and this produces an isolation which seriously impairs the effectiveness of the individual lone immunologist who finds himself in a department whose main interest is centred elsewhere.
61. The Government research institutes in Britain (Mill Hill Laboratories of the MRC) and USA (National Institutes of Health, Bethesda) do eminent work in immunology and it would be desirable to have similar institutes in Canada, though they might function as graduate institutions in conjunction with existing Universities.

Table 1: Grant Support for Immunological Research (1967-8)

| Area of Immunology | Number of Research Projects Supported by | | | | | | Total |
|---|--|----|-----|------|-----|-----|-------|
| | MRC | PH | NCI | CARS | DRB | BRF | |
| a) Allergy autoimmunity, immunopathology | 23 | 3 | | 4 | | | 30 |
| b) Immunochemistry | 21 | 1 | | 3 | | 2 | 27 |
| c) Transplantation, immunosuppression | 8 | 4 | | 1 | 1 | | 14 |
| d) Cellular immunology | 15 | 1 | | | | 1 | 17 |
| e) Microbial immunology | 9 | 8 | | | 3 | | 20 |
| f) Cancer immunology | 1 | | 15 | | | | 16 |
| TOTAL | 77 | 17 | 15 | 8 | 4 | 3 | 124 |

In the case of the major granting agency, the MRC, the 77 immunology grants make up about 7% of their 1008 operating grants issued in 1967-68.

Table 2: Distribution of Research Grants for Immunology in
University Departments

| Department | Number of research projects supported by | | | | | | Total |
|---|--|----|-----|------|-----|-----|-------|
| | MRC | PH | NCI | CARS | DRB | BRF | |
| Microbiology <u>or</u> Bacteriology) or Bacteriology and Immunology) | 15 | 3 | 3 | 1 | 2 | | 24 |
| Pathology and Path. Chemistry | 11 | | 1 | 2 | | | 14 |
| Medicine <u>or</u> Experimental Med. | 10 | | 1 | | | | 11 |
| Biochemistry | 4 | | 2 | | | 1 | 7 |
| Surgery <u>or</u> Experimental Surg. | 4 | | 1 | | | | 5 |
| Medical Biophysics | 2 | | 1 | 1 | | | 4 |
| Physiology | 2 | | | | | | 2 |
| Anatomy | 1 | | | | | | 1 |
| Chemistry | 1 | | | | | 1 | 2 |
| Cancer Research | 1 | | | | | | 1 |
| Ophthalmology | 1 | | | | | | 1 |
| Obstetrics and Gynecology | 1 | 2 | | | | | 3 |
| Paediatrics | 2 | 3 | | | | | 5 |
| Parasitology | | 2 | | | | | 2 |
| Pharmacology | 1 | | | | | | 1 |
| Psychiatry | 1 | | | | | 1 | 2 |
| Zoology or Biology | 1 | | 1 | | 1 | | 3 |
| Hospitals | 16 | 4 | 4 | 4 | | | 28 |
| Research Institutes | 3 | 3 | 1 | | 1 | | 8 |
| Total | 77 | 17 | 15 | 8 | 4 | 3 | 124 |

46. In addition there are two or three dozen other journals in the biomedical sciences with a 10-30% content of immunological articles.
47. Another index of the importance of current research activities by immunologists is that about 12% of the letters to "Nature", relating to the whole of the biological sciences, deal with immunology.
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APPENDIX 107

CANADIAN SOCIETY
FOR
CLINICAL INVESTIGATION

A BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF
THE SENATE OF CANADA

1969

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BRIEF from the CANADIAN SOCIETY
FOR CLINICAL INVESTIGATION to
the SPECIAL COMMITTEE ON SCIENCE
POLICY OF THE SENATE OF CANADA

MAIN POINTS AND RECOMMENDATIONS

1. The ultimate goal of health research is improved health care of the community. In realizing this goal, the full range of available knowledge must be brought to bear by well-trained people in the most effective way. Health research is basic to the provision of knowledge, the training of people, and the delivery of health care.

The availability of health services is being extended. The base for training health personnel is being expanded. There is a commitment to provide health care of high quality.

It is imperative that the necessary, supporting research activities be properly provided for.

Recommended that the Federal and Provincial Governments make provision for health training and health research in a manner appropriate to the magnitude of health activities in Canada and the importance of health to the Canadian people.

2. The Federal Government has not made a statement of policy regarding the financial support it will provide for health training and health research. As a result, it has been impossible to formulate and carry out planned programmes for developing health manpower, recruiting staff to health sciences centres, and conducting good scientific research.

A declared policy is necessary. In this way, the harmful effects of start-stop financing will be avoided.

Recommended that the Federal Government adopt and announce a long term financial policy for health research and for upgrading health training facilities.

Special Committee

3. Provincial governments have not stated their policies and plans for health services and health care systems. As a result there has been unco-ordinated expansion of facilities and overly expensive arrangements for delivery of health care.

Such statements of policy and plans are necessary. Knowing them, the many agencies, institutions and professions involved in research, training and delivery of care can frame their own policies and plans.

Recommended that Provincial Governments draw up and announce their long-term plans for the development of health services and health care systems.

4. Health research is supported by the Federal Government in two ways. Capital funds for research and training facilities are provided through the Health Resources Fund. Operating funds are provided primarily through the Medical Research Council (for research programmes in medical and associated health sciences), and also through the Department of National Health and Welfare (for research into other aspects of health care).

Recently, a ceiling has been placed on the annual disbursement of capital funds and the rate of growth in operating funds has been slowed. The expansion in health manpower and facilities that is underway is at a crucial stage and is being set back by these restrictions.

Recommended that the Federal Government:

- restore the rate of growth in funds for the Medical Research Council to that of prior years, such funds to be allocated in accordance with national standards of excellence,
- increase its provision of funds for research in the broader aspects of health care delivery,
- make available capital funds in accord with the needs of areas and institutions, rather than on the basis of a fixed, annual amount which is unrealistic in a long-term programme of expansion.

5. Provincial Governments have been content to rely, in research, on actions and programmes at the federal level. Provinces have devoted an extremely small part of their health expenditures to research.

Recommended that Provincial Governments greatly increase their provisions for health research, and in particular for:

- research into health delivery systems and arrangements,
- the establishment of new investigators in the health sciences,
- research in fields not being covered by other granting agencies.

6. Serious lags and deficiencies exist in particular fields of health research and in the amount and quality of health research being carried on in particular centres. These must be recognized and corrected if the training of health personnel and the quality of health services is not to be further impaired. Additionally, the needs of new institutions being established must be recognized.

Recommended that the Federal and Provincial Governments make special arrangements to overcome lags and deficiencies in health research in particular fields and centres, and to provide for the needs of new institutions.

7. Relationships in the field of health are very complex. Involved are two levels of government, a number of government agencies, individual universities and hospitals, and several professions. Arrangements for consultation, co-operation and co-ordination are inadequate and sometimes non-existent.

Recommended that all those engaged in the field of health - governments, agencies, institutions, professions - recognize that consultation, co-operation and co-ordination are essential for achieving health goals in an effective way.

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BRIEF from the CANADIAN SOCIETY
FOR CLINICAL INVESTIGATION to
the SPECIAL COMMITTEE ON SCIENCE
POLICY OF THE SENATE OF CANADA

INTRODUCTION

Following informal groupings dating from the 1940s, the Canadian Society for Clinical Investigation was incorporated in 1961 and has a current membership numbering just over 400. The Society's members are about one-quarter of the total number of investigators in the medical sciences in Canada.

While the purpose of the Society is to act as a forum for clinical medical science, all aspects of medical research are covered in the composition of its membership and the scope of the research it fosters. Investigations by members range from exploring the functioning of subcellular particules in a highly-sophisticated laboratory setting to investigating the mechanisms and treatment of disease in man as an individual and in his social setting.

Clinical investigators generally hold dual appointments - in a university medical school and in an associated teaching hospital - and thus function as researchers, educators and providers of patient care. This breadth of involvement particularly qualifies this Society to address the Committee on the matter of research in the health sciences in Canada.

THE ROLES OF CLINICAL
INVESTIGATORS IN CANADA
TODAY

The three functions of a clinical investigator (research, education and patient care) are interrelated and it is impossible in practice to say where one leaves off and the other begins. However, in order to bring out the nature of research and its importance for high quality patient care and education, each of these aspects is discussed in turn.

The Investigator and Research

Investigators in their research capacity seek to advance knowledge. The ultimate goal of their research is improved health care of the community. This is achieved in various ways and by different kinds of research.

Some research is concerned with the study of basic functions and mechanisms. At first glance, these seem remote from application in human disease and may therefore appear to be of little practical value. However, it must be recognized that the causes of disease are usually so complex that the eventual solution may involve the application of knowledge from many areas. It is, in fact, difficult to predict which of many growing points in studies of fundamental mechanisms will be most relevant to the understanding of the causes of any specific disease. As Sir Peter Medawar has asked: "If we knew of a direct pathway leading to the solution of the clinical problem of rheumatoid arthritis, can anyone seriously believe that we would not take it?"

A second type of research - clinical investigation of the mechanisms and treatment of disease in man - is the particular interest of most of the members of this Society. It requires that normal function be examined and understood before abnormality can be appreciated. For these purposes, knowledge is used from all aspects of scientific investigation, together with new knowledge arising in the treatment process itself.

Finally, and moving beyond medical research as such, there is research into the problems of most effectively delivering health care to the patient in a community setting. This is an aspect of health research on which more will be said later.

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There are two points that must be stressed about medical research in Canada in today's conditions.

1. The traditional classifications of research as "basic" or "clinical", "pure" or "applied", have virtually no current relevance. Research is a continuum ranging from the search for new knowledge to its application in treatment, and using the skills and expertise of investigators in all areas of medical science and in other scientific disciplines also (physics, engineering, mathematics).
2. As a corollary, the lag between discovery of new knowledge and its application in treatment has shrunk from a matter of years to practically nothing. In particular, knowledge arising in fields that are classed as "basic" or "fundamental" is very rapidly being taken up and applied in patient care.

The three types of research outlined above have led to advances at all levels of medical science and have had applications in various aspects of health care. International endeavours have unravelled the genetic code, identified the various types of poliomyelitis virus and developed programmes of preventive immunization, found drugs to cure tuberculosis, developed the heart-lung machine to permit open heart surgery, and are uncovering the structure of proteins involved in immunity, to cite but some of the discoveries. Canadian medical scientists have played a role in these international efforts.

In addition, Canadians have made contributions in various specific areas. Some examples of their work in the last ten years follow.

1. In the field of coronary artery disease, the major cause of death today, investigation of the role of the blood platelet in obstructing the arteries (resulting in heart attack) is leading to improved understanding and testing of remedial treatment. Canadian hospitals pioneered in establishing intensive care units for treatment of a heart attack. Pacemakers were developed to overcome heart block. Some patients with angina are benefitted greatly by the surgical technique of implanting an artery, taken from the chest wall, into the heart muscle. A new operation has corrected one of the defects that results in the "blue baby".

2. In the field of lung disease, a radio-active gas technique has been devised that permits study of the interrelationship of blood and air flow in and out of any part of the lung. Other studies have elucidated the abnormal breathing patterns in chronic bronchitis. This work has permitted the development of home care programmes for the treatment of patients with chronic lung disease.
3. Research in diseases of the blood has permitted the detection, consequent earlier treatment, and now prevention, of Rh disease. The development of methods of preparing blood clotting factor concentrates now permits the prevention and treatment of bleeding disorders such as hemophilia and Christmas Disease. Preservation of blood in the frozen state has led to the development in Canada of one of the world's most outstanding rare blood banks.
4. In the field of endocrinology, greater understanding of the hormonal causes of high blood pressure has led to improved diagnosis and treatment. Research in human growth hormone has resulted in a nation-wide programme to study its effects in children dwarfed because of this hormonal deficiency. A Canadian was co-discoverer of a hormone from the thymus gland that may play an important role in immunology and transplantation. Earlier discovery of a hormone from the parathyroid gland that affects the level of calcium in the blood was recently followed by the discovery of a second similar hormone, calcitonin; calcium is basic to muscle contraction and bone formation.
5. Research into the process of cell differentiation has resulted in a significant alteration of the drug treatment of cancer. The discovery that tumors of the bowel may be antigenic may significantly alter treatment in this form of cancer.
6. In the field of biochemical genetics, enzyme defects have been discovered which lead to abnormal metabolism in the affected child and thence to disease, mental retardation or death. Canadian research centres have participated in the discovery of these enzyme defects and have developed screening tests for abnormal amino acids in urine, which can lead to appropriate care.

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7. In other fields, recent research in brain function in patients with Parkinson's Disease has led to impressive new methods of drug treatment. Investigations into the mechanisms of the shock state (where the blood pressure is low or unobtainable) have completely changed the basis of treatment. The discovery of the Barr Body (sex chromatin) has had wide implications in the understanding and diagnosis of a number of inherited disorders.

These examples, which are only a selection from many, give some indication of the fields of investigation of Canadian medical research workers and of the way in which such activities range from fundamental investigation to discoveries used at once in treatment. Canadian investigators are part of the international medical scientific effort, but their contribution is not what it might be. In this connection a recent assessment stated*

Canada's position in medical research is, over all, one of modest accomplishment. There are many points of excellence, and those who have achieved international recognition may well be proud of the contributions they have made under conditions that until recently, were, for the most part, very difficult. But the broad areas where additional strength is needed are still too numerous.

This Society concurs in this assessment and later will be discussing the conditions necessary to establish Canadian medical research at a level appropriate to a wealthy and developed country.

The Investigator and Patient Care

Clinical investigators working in hospitals associated with university medical schools are the focus through which the advances emerging from research (of the kind described already) are applied in patient care. In order to apply new knowledge and techniques developed in Canada or elsewhere, they must be highly competent and be working at the forefront of knowledge in their fields.

Research findings are published and available to all, but it takes other research workers to adapt them, to introduce them, and to establish them as regular procedures. An example is kidney dialysis and transplants; such activities are quite common now, but they would not have

*Canadian Medical Research, Survey and Outlook, Medical Research Council, Canada, Report No. 2, 1968, page 10.

begun in Canada, nor could they continue, without the involvement of researchers actively investigating the workings of the kidney.

Within hospitals, individuals and teams can be involved in various ways in research and patient care. Certain investigators may function in Intensive Care Units (coronary, respiratory, renal dialysis and transplantation, shock) which bring the latest in knowledge and techniques directly to the treatment of individual patients. Other investigators may work in Investigation Units (clinical, cardiovascular, respiratory) which explore functional abnormality in disease with the aim of improving diagnosis and treatment. Still other investigators may concentrate particularly on research as part of a hospital-based team, and may have limited immediate involvement in patient care.

Whatever the orientation and the grouping, it is essential that the clinical procedures directed to patients draw on a variety of knowledge from many different fields, and this more often than not means the working of an interdisciplinary team which encompasses a range of "clinical" and "basic" personnel. Thus a kidney transplant requires the skills not only of a surgeon, but also of a nephrologist and immunologist, with the choice of donor being determined by criteria developed from research findings in Canada and elsewhere. Similarly, current work in high blood pressure, (which is an immediate clinical problem), requires the skills of a protein chemist, steroid biochemist, physiologist, and electron microscopist, beside those of the physician attending the patient. Ongoing work in cancer requires the skills of a wide range of scientific personnel, medical and non-medical, extending as it does from investigation of cell function to treatment applications for human patients.

Although the major contribution of clinical investigators is centred in teaching hospitals associated with medical schools, the contribution of their research programmes can also extend beyond the walls of the hospital. For instance, study of the mechanics of breathing in chronic chest disease has developed into a method of treating chronic chest disease in the home on a continuing basis, with benefits to the individual and to the hospital in resources set free for other purposes. Another example of a home care programme

using advanced techniques is home dialysis for patients with kidney failure, through which they can stay active and out of hospital.

Both within and outside the teaching hospital, then, discoveries arising from investigations in many fields of medical and non-medical science are brought to bear in patient treatment. Clinical investigators, with their various capacities and skills, are an integral and essential part of the patient care delivery team. If the quality of patient care to be made available to the people of Canada is to be in accord with the potential offered by present developments in medical knowledge, it is essential that medical scientists of high calibre be present in our universities and teaching hospitals in increasing numbers. As is indicated later, the present corps of medical researchers in Canada is not yet as large or as skilled as it ought to be, and prospects for future improvement are not good unless there is action to overcome present financial and organizational inadequacies.

The Investigator and Education

The foregoing descriptions of the role of the investigator in research and in patient care may also have provided an initial indication that investigators have a significant role to play in the education process, since they provide an awareness of those developing areas in medical science that are apt to have a major impact on human disease over the next 10 - 20 years. In almost all schools in Canada, medical scientists are actively involved in reorganizing the curriculum so that medical undergraduates may be best prepared to assimilate the mass of new information which will become available during their active careers in medical practice.

Until comparatively recently, the teaching of medicine was more an art than a science and facts were taught because mechanisms often were not known. (Insulin has been used since the '20s, sulphonamides since the '30s and penicillin since the '40s, but most of the knowledge of their mechanisms of action has been obtained only in the last ten years.)

The explosion in medical knowledge in the past twenty years or so has meant that it has been necessary to be selective in what is taught during the student's undergraduate years. As part of this, almost all medical

schools are insisting that students gain an understanding of the new sciences that are having an effect on medical care, e.g. in the fields of molecular biology, immunology and transplantation, mechanisms of drug action, biophysics, and biomedical engineering.

There has been some criticism of these developments, along the line that the function of a medical school is to turn out practising physicians and not scientists. Such statements are pernicious because they suggest that modern society and the state of medical knowledge do in fact place these two alternatives before medical educators; this is not so. Medical science will place in the hands of physicians of the future new and exceedingly powerful tools. The more powerful the tool, the greater the need for the practitioner to understand the scientific principles upon which its efficacy, and indeed its dangers, depend. Every doctor must in some measure be a scientist even if he never sets foot in a laboratory; for him to be otherwise would not only be retrogressive but dangerous to the health of his patients.

Thus the installation into the minds of young physicians of those principles of medical science which are currently available is not designed to produce more scientists but to prepare the way for the proper introduction into medical practice of new approaches deriving from discoveries that experimental scientists will make. Clearly then, medical education must involve the medical scientist if it is to serve the best interests of society. Additionally, the medical scientist will bring to the medical school awareness of what is apt to influence medical practice in the immediate and not-so-immediate future, and thus will contribute to modification in the medical curriculum which must be designed to meet needs ten years hence.

It might be mentioned that the tendency in modifying curricula is to focus on a basic core of essential knowledge and, through electives, to provide flexibility for the individual student. Most importantly, medical teaching is thus moving toward the proper function of education - the transmittal of the learning attitude and learning process. By developing in students the enquiring attitude that is characteristic of the researcher, the medical graduate is prepared for the life-long learning process necessary for today's practitioners of medicine.

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Besides these educational functions and responsibilities toward undergraduate medical students, the medical scientist has a prime function in the development of graduate students. There is growing exposure to research of residents in specialty training, and this is beneficial in their approach and attitude to patients. For graduates registered formally in advanced degree courses, research is of course an essential component of their training, and it is imperative that this research be carried on under the guidance of first-class medical scientists if the result is to be the development of a new generation of investigators of similarly high calibre.

Activities in continuing education are also a most important function for the medical investigator. Informally, there is a diffusion of new knowledge to colleagues; formally, medical scientists foster the spread of knowledge through lectures, post-graduate courses and - very significantly in recent years - medical television programmes. With the major developments that are occurring in medical science, the further strengthening in continuing education becomes even more important.

THE CHANGING ROLE
OF MEDICAL FACULTIES
AND TEACHING HOSPITALS

Clinical investigators carry on their research primarily in teaching hospitals, and it is in these locations that the most advanced knowledge, techniques, procedures and treatment are to be found, in Canada as in other countries. As one moves away from these university teaching centres, there is a decrease in research involvement. This is appropriate to the developing grouping of teaching and community hospitals which are being seen as the constituents of regional programmes for health care. Under such a system, there would be an outward dissemination of knowledge and skills from the most highly specialized centres at the core, and an inward flow of patients requiring particular types of advanced treatment to the centres where it can be provided most effectively.

This is the direction in which health care delivery is moving in Canada. Most provinces are endorsing such forms of organization and are beginning to frame their planning along these lines. Several matters should be noted, however.

1. The concept of regionalization is well developed in Canada and the extending coverage of medical insurance will permit a greater quantity of medical care to be delivered to Canadians.

But regionalization brings with it a commitment to provide excellence in specialized programmes and areas of medical care. The quality of the care provided in these centres depends in large part on the calibre of the clinician-scientists working in them. Unless conditions are such as to provide a solid foundation for the medical research carried on in the university and its teaching hospitals, the number and calibre of investigators will be inadequate to provide medical care of desirable and possible standards.

2. Along with the trend to regionalization has been occurring a shift in the role of the hospital (teaching or otherwise) in health care delivery. Health care is increasingly becoming hospital-based and the different professions in the health field are becoming increasingly interdependent.

In recognition of this, universities are grouping their training of health personnel under broader organization arrangements (Vice-Presidents for Health Sciences), and are creating Health Sciences Centres (including teaching hospitals) in which health personnel (medical, dental, nursing, pharmacy, other paramedical) can take certain common training in readiness for their activities as part of the health teams foreseen for the future. Investigators knowledgeable of the course of medical science and its effect for the future are an essential component in such arrangements.

3. As part of these general developments, there is increased awareness of the need for research and scrutiny of broader aspects of health care and health delivery. The Science Council has stated (Report No. 4, page 46) "the entire health care system, involving general practitioners, nurses, specialists, clinics, hospitals, sanatoria, has evolved over the years in essentially a random way", and it indicated health care delivery as an area to which it wished to give serious consideration.

Research is required into the type of health care that will be appropriate to future community health needs; into the forms of organization that would most effectively deliver that care at least cost; into the regroupings and transference of functions among personnel in the health professions for their greater effectiveness; and into the form and arrangements for health education and training.

Members of this Society are an integral part of these general developments in the health care field and recognize the importance of wide assessment for the transformation of present activities into a more co-ordinated health care delivery system. Being experienced investigators in their own fields, clinical scientists can critically evaluate and constructively contribute to such wider aspects of health research.

At the same time it must be recognized that, whatever the new groupings and teams and organizations for the delivery of health care may be, the physician will continue to be the focal point and the standard of his training and performance will be crucial for the quality of health care that will be delivered. The Science Council recognized (Report No. 4, page 14) the

need for "continued medical research to ensure that the standards of training and practice in Canada's health professions are of a quality that is high by world standards".

Toward this end, this Society considers it imperative that first-class medical scientists be present in Canadian medical schools and teaching hospitals in increasing numbers. Their activities are an essential part of the new forms of health care delivery that are developing in Canada. Their research, together with research into broader aspects of health care, constitute the broad continuum of health research.

Realization of health goals in Canada requires the provision of appropriate resources for all aspects of health research.

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MEDICAL RESEARCH
IN CANADA

The earlier statement that the standard and numbers of medical investigators are not satisfactory in Canada was not a subjective judgment. It derived from the detailed inventory of Canadian medical research resources and outlook that has already been referred to (Medical Research Council Report No. 2, 1968). While this survey revealed many points of excellence and achievement of international recognition, the fields and areas where additional strength was needed were found to be numerous.

It should be recognized that conditions for the development of medical research in this country were very poor until three years or so ago. Facilities for the conduct of research in universities and hospitals were based on the standards and conditions of prior decades. Representations for provision of capital funds to overcome deficiencies went unanswered until 1966, when the Health Resources Fund was established as a federal contribution to provincial expenditures for a wide range of health training and research facilities including teaching hospitals, medical schools and training facilities for other health personnel. As plans were formulated and construction started, disbursements from the fund (matching provincial expenditures) grew from \$4.7 million in 1966-67 to \$32.6 million in 1967-68 and \$37.5 million in 1968-69. The Department of National Health and Welfare has stated in its Brief to the Senate Committee that \$2.1 million of the disbursements in 1966-67 and \$10.0 million of those in 1967-68 were for research facilities.

On the side of operating funds in support of research programmes, the total available in 1965-66 from all sources was \$22.8 million. This Society, concerned that these amounts were much too low for an appropriate level of medical research effort in Canada, initiated and commissioned a comprehensive survey of medical research in Canada that developed, perhaps for the first time, an objective measurement of research activity and future financial requirements. This study (known as the Gundy Report after its sponsor Mr. C.L. Gundy) carried the signature of over 600 Canadian medical scientists when it was presented to the Prime Minister in January 1966, and

appears to have had some influence on subsequent events. A supplementary provision was made available to the Medical Research Council in 1966, and an indication that the former annual rate of increase in its funds of 33 1/3% was to be continued gave a basis for confidence in the future.

These developments of the mid-1960's meant that, after many lean years, it became possible to begin planning physical plant in universities and hospitals that was appropriate to modern medical research conditions. Appointments could be offered to Canadians who had gone to the U.S. for lack of opportunity to work in Canada and also to leading U.S. investigators. Potential researchers that appeared among the student body could be encouraged, in all honesty, to pursue their inclinations since it appeared that future conditions for the exercise of their talents would be reasonably satisfactory; many new individuals embarked on research training programmes. (The ability to plan ahead and to provide continuity is extremely important in medical research. It may take a clinical investigator twelve years to be qualified and recognized as such, after his entry to medical school.) By 1968-69, total funds available for Canadian medical research, at \$44.5 million, were double those in 1965-66; of the total, \$27 million was being disbursed through the Medical Research Council.

These developments were essentially a belated response to inadequacies that had been apparent for some time. They did, however, give some promise that there would be satisfactory conditions for the expansion that is in prospect in the decade ahead, arising from growth in the twelve existing medical schools and formation of new schools at McMaster, Sherbrooke, Calgary, and Memorial. The Medical Research Council Report No. 2, already referred to, found on the basis of staff expansion plans that the number of medical investigators in universities and hospitals could realistically be expected to increase from 1,365 in 1966-67 to 2,596 in 1972-73, a growth of 90%. In light of this expansion, it was considered mandatory that there be growth in disbursements from the Health Resources Fund as physical projects passed from the planning to the construction stage, and that there be continued substantial growth in operating support through the Medical Research Council so that staff could be attracted in sufficient numbers from the U.S. and

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elsewhere. Major expansion in the financial resources made available seemed only appropriate to increasing per capita demand for health services and government demands that more medical and health personnel be trained.

It was in this context that the news was received of a ceiling of \$37.5 million in annual disbursements from the Health Resources Fund and a slackening in the rate of growth in Medical Research Council funds to 14.7% in 1969-70, less than half what it had been before. These developments reflect, of course, present financial stringency, and health has perhaps fared better than other programmes (including science programmes).

These changes in conditions, however, could hardly have occurred at a worse time in relation to a long-term programme for expansion in the health care base and framework in Canada. The importance in health care delivery systems of medical researchers in their role as scientists, educators and providers of patient care has been noted earlier. The development of such individuals takes time and the ability to achieve a good yield in research activity does not occur quickly. Generally there is need of a gradual build-up in teams and in knowledge, and this is very sensitive to changes in conditions arising from tightening of the financial tap. Correspondingly, resumption of growth cannot be accomplished rapidly, since rebuilding and reconstituting takes time.

The last few years have seen the establishment of a basis for sound development in medical research in Canada. Recent events have set this back several years.

In planning for provision of physical facilities, some provinces are more advanced than others and have more projects coming into the construction state; their ability to proceed is being hampered by the ceiling on the Health Resources Fund and, among the lagging provinces, an impetus toward establishing their policy and plans has been removed. The suggestion of a fixed annual ceiling on disbursements from the Health Resources Fund is most unrealistic. In expanding health training and research facilities across Canada, it is more reasonable to expect major requirements for funds at the time that building projects are ready to commence.

The slowdown is having a major effect on the willingness of individuals to pursue research careers in Canada. The change in conditions is well known both here and in the United States. Recruiting of new personnel is being hindered by inability to offer necessary space and equipment and by restraint in funds for research programmes. As the following table shows, the award rates for grants-in-aid of research and personnel support by the Medical Research Council were at comparatively low levels even in 1968-69; in 1969-70, on the basis of commitment of the bulk of the funds available, award rates in personnel programmes were barely greater than in the previous year, and in operating grants were at the lowest level since the Council's inception.

Medical Research Council
Award Rates 1962-70

Per Cent of Number
of Applications that
Obtained Support

| | <u>Operating Grants Programme</u> | <u>Personnel Support Programmes</u> |
|-------------------|---------------------------------------|---|
| 1962-63 | 63% | 63% |
| 1963-64 | 55 | 67 |
| 1964-65 | 59 | 59 |
| 1965-66 | 51 | 59 |
| 1966-67 | 69 | 79 |
| 1967-68 | 63 | 55 |
| 1968-69 | 52 | 40 |
| 1969-70 (to date) | 47 | 41 |

The shortage of funds means that the standard for acceptance of research projects becomes even higher than before; and the effect is thus experienced particularly by new investigators attempting to become established and by centres seeking to expand their scale of research activities to appropriate levels. As an example, it is possible this year (1969-70) to fund only about one-third of new project applications to the Medical Research Council.

As the Council Chairman stated to the Senate Committee on February 13 of this year - "The gap then between what the Council would like to support because of its merit, and what it is able to support in the light of its funds, has been increasing".

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This recent experience indicates the harmful effects of start-stop financing on long-range scientific programmes such as the development of health manpower, staff recruitment to health sciences centres, and fostering of good health research. It is most important that the Federal Government adopt a consistent financial policy for a longer time interval, and make it known so that all others in the field of health can, in turn, frame their own policies and plans. This is particularly required at the present time, when the availability of health services is being extended, the base for training health personnel is being expanded, and there is a commitment to provide health services of high quality.

THE NEED FOR POLICY
AND PLANNING IN
HEALTH FIELDS

The need for policy and planning to achieve future goals is nowhere better illustrated, perhaps, than in the field of health.

Taking medical research as an example, the following are the essential conditions for establishment of new investigators and the effective performance of research by all investigators:

1. Good people must have been trained in adequate numbers. Their salaries will normally come from the operating budget of the institution in which they are working. This is generally a university or hospital, and the source of funds is the provincial government.
2. Investigators must be housed in a building with facilities appropriate to modern research. The construction of such training and research facilities is initiated by provincial governments, universities and teaching hospitals, with the federal government contributing to the capital cost through the Health Resources Fund.
3. Such facilities require basic research equipment before investigators can start their programmes. The equipping of new and renovated research space is a responsibility shared by provinces and institutions on the one hand, and the federal government through the Health Resources Fund on the other.
4. In conduct of their research programmes, investigators require support for the costs of their operations. This is mainly obtained from federal financing sources (Medical Research Council primarily, and Department of National Health Welfare to a much lesser extent). Included in such operating support will be funds for the periodic purchase of equipment.

The conduct of medical research thus requires participation and co-operation between two levels of government and a number of agencies and institutions, but the necessary degree of co-ordination has not existed. For instance, it can be readily seen that all four conditions outlined above must be operative for the establishment and continuation of research. In practice this does not always happen, particularly now when adequate funds are not available.

Thus lack of funds for start-up equipment (because regulations under the Health Resources Fund unrealistically require precise specification of equipment needs several years ahead) has resulted in research quarters remaining unused although investigators were ready and waiting. In certain cases, new research space is empty because the university budget cannot provide salaries for staff nor are the funds available for start-up equipment. In other centres, where research activity has been seriously restricted by lack of space, the indefinite postponement of much-needed building projects is preventing the development of an appropriate level of research.

These are examples of difficulties arising as a result of the current shortage of funds and lack of planning and co-ordination.

In more general terms, and considering the broader field of health research, the needs for co-ordination are many:

1. Provincial governments have the initiative for policies related to health and education, and have provided capital and operating monies to medical schools and teaching hospitals through Departments of Health, of Education, and of University Affairs, with Hospital Services Commissions (or equivalent) exerting an influence also. The evidence available to the Society's members across Canada is that there has been a lack of co-ordination among these agencies and an absence of urgency in adapting structures and arrangements in accord with changing conditions.

There are indications that changes are underway. In Manitoba, a Health Sciences Co-ordinating Council drawn from hospitals, university bodies and government agencies, is being established for the 20-year \$100 million Manitoba Health Sciences Centre. In Ontario, a Council of Health is examining the health requirements of the province in many different aspects, with a Health Research sub-Committee looking at the needs, planning and co-ordination of health research defined in its broadest sense.

In general, however, provincial authorities have been content to rely, in research, on actions and programmes at the federal level. Provinces have devoted an extremely small part of their health expenditures to research.

There is need for increased provincial initiatives in health research in general and, particularly, for research into health care delivery systems and arrangements, establishment of new investigators in the health sciences, and support of research activities in fields not being covered by other granting agencies. In this latter respect, the practices of the voluntary agencies - acting as complements to other granting bodies - could be most usefully emulated.

2. The Federal Government in past years has acted as a sponsor and as a partial provider of funds for programmes in health and education fields (hospital insurance, higher and technical education and - currently - medical insurance).

In research, the Federal Government has been the main provider of government funds, through the Medical Research Council and the Department of National Health and Welfare (about \$30 million and \$5.5 million respectively in 1969-70 in operating support) and \$37.5 million in capital through the Health Resources Fund for research and training facilities.

These programmes for expanding research activity have not been free of defects arising from lack of co-ordination, as earlier remarks have indicated. In general, however, they have worked reasonably well because the medical school has been the link between provincial decisions on facilities expansions and federal decisions on operating support for research.

It is desirable, however, that there be more high-level and detailed consultation and co-ordination between the federal and provincial governments to arrive at a planned programme for expansion in the health base and health facilities across Canada. There is need for agreement on the programmes and the funding mechanisms which will achieve health goals, will bring about co-ordinated expansion in expensive health facilities, and will provide appropriate funding for the range of health research which is necessary to advance the quality of care itself and improved delivery of care.

The need to strengthen performance and personnel in particular fields of endeavour or geographic locations should be accomplished by special provisions for such purposes. The Medical Research Council should continue to be the channel for medical and associated health science research funds allocated in accordance with national standards of excellence. A greatly expanded provision of federal funds for research in the broader aspects of health care delivery is most necessary and long overdue.

3. At the level of the individual institutions there is need, also, for improved policy, planning and co-operation.

Medical schools in their planning need to give close attention to the changing health needs of the community. Teaching and non-teaching hospitals will have to incorporate their expansion plans into a co-ordinated framework for provision of service on regional and sub-regional bases. New institutions and new methods of providing care have not been developed and the effectiveness of the old has not been raised. Full advantage has not been taken of the complementarity of the health professions, working together.

There is room for action by all those engaged in the health field. This Society, for instance, should consider what it might do to improve the delivery of health care through new screening programmes for particular diseases, participation in training of health personnel, and intensified continuing education programmes, for example.

The Royal Commission on Health Services placed great stress on the need for involvement by all participants in the health field in the policy and planning process and, in Chapters 7 and 8 of Vol. II, confronted and discussed the organizational and institutional problems underlying effective operational arrangements. The detailed recommendations that the Commission made in these respects may not necessarily be appropriate, but it is disappointing that there has been so little consideration of these matters since the Commission reported five years ago.

In Vol. I of its Report, at page 10, the Commission stated:

"... we were impressed with the fact that the field of health services illustrates, perhaps better than any other, the paradox of our age, which is, of course, the enormous gap between our scientific knowledge and skills on the one hand, and our organizational and financial arrangements to apply them to the needs of men, on the other.

What the Commission recommends is that in Canada this gap be closed. That as a nation we now take the necessary legislative, organizational and financial decisions to make all the fruits of the health sciences available to all our residents without hindrance of any kind. All our recommendations are directed toward this objective.

There can be no greater challenge to a free society of free men."

The Canadian Society for Clinical Investigation associates itself with this recommendation. The Society in this Brief has indicated how medical scientists, in their capacities as researchers, educators and providers of patient care, are contributing and can contribute to the realization of such health goals in Canada.

APPENDIX 108

BRIEF
TO THE
SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE
SENATE OF CANADA

Submitted
for
THE CANADIAN PHYSIOLOGICAL SOCIETY

by

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SUMMARY

Fundamental scientific teaching and research, as distinct from applied and developmental research, will continue to have intrinsic value and to provide the major part of the initial indoctrination and practical training of scientists. As such fundamental science is largely pursued in Universities, the brief concerns itself mainly with some special influences on the effectiveness of scientists in the University.

It is advanced that the weak link in present support of scientific activity in Universities is a failure to provide the academic scientist with enough uncommitted time to do quality work. This constraint on his effectiveness will grow worse as University enrolment grows, and will not be counteracted even by adequacy of funds for space, equipment and assisting personnel. Science policy cannot therefore be divorced from policy determining the support and evolution of places of higher education if increased funding is to be used efficiently; this end will partly depend on a more realistic acceptance within the University circles of research as a primary responsibility. One possible direction of such academic evolution would be the division of traditional science departments into sub-departments of teaching and of research and graduate training; the latter could be strengthened by the provision of more subsidized full-time research positions and Research Units. It is considered important that such Units not be separated from the University and that the association is best served if their problems are fundamentally oriented.

It is proposed that science policy formulation should consider the desirability of Canadian scientists becoming increasingly independent in the field of scientific documentation. This aim could be assisted by subsidization of publication of reviews, symposium reports, monographs and textbooks to be prepared by workers in this country. It is also proposed that short-term leave periods be sponsored through appropriate agencies to allow and encourage the preparation of scholarly works.

In considering the role of government, it is suggested that new support programs be designed to ensure the growth of effective research environments in Universities without depriving the scientist of independence of initiative. At the same time such programs should not undermine the parallel development of the teaching functions of the University. Close consultation with appropriate academic representatives and operation through experienced funding bodies, such as the Medical Research Council, would help to avoid undesirable consequences of new forms of support which might lead to redirection of University effort.

The predicted saturation of the academic market for Ph.D. graduates in physiology is alluded to. In the future, a proportion of new Research Units could reasonably be concerned with applied research. This would provide both training and employment opportunities for future young scientists who may soon find other academic positions unavailable.

Emphasis is placed on ensuring the participation of Faculties (or Schools) of Graduate Studies in any science policy formulation which bears on measures to develop more effective research environments within Universities. Some dangers are seen in support being subject to value judgements which may be

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increasingly based on pragmatic considerations; it is likely that most academic physiologists, for example, would prefer to see special programs of support continue to be administered by the Medical or National Research Councils. Professional societies should at least be informed of considerations which ultimately will alter their working conditions.

The brief concludes by the recognition that although academic physiologists are not uninvolved in the social and health problems of our age, it would be better to concentrate on consolidating our present position before considering a major broadening of our responsibilities.

1. Science policy enquiry should encompass all factors which directly bear on successful perpetuation of knowledge, dissemination of such knowledge and associated skills in potentially productive directions and advancement of this knowledge by creative activity. The first two of these functions rest largely with the teaching profession, particularly at University level; the last function is carried out in several areas, one of which is the University.
2. The Canadian Physiological Society consists largely of physiological scientists with University positions, usually in medical faculties, whose professional responsibilities are defined to include teaching and research. A minority of practising physiologists in Canada, some of whom belong to the Society, have positions in government biological stations and defence research establishments, pharmaceutical houses and industrial concerns (Appendix 1). University based physiologists do the lion's share of perpetuation and dissemination of the knowledge of their science and are almost solely responsible for the initial training of physiologists. The research they do is more or less fundamental but the strong association with clinical medical teaching and practice, as well as the source of their research funding, leads to some predeliction in choice of research problem for subjects of ultimate medical relevance. On the other hand, research done outside Universities is usually more applied or developmental. The scope of physiological research done in Universities is broad, and is dealt with in some detail in the Report No. 2 of the Medical Research Council ¹; it should be emphasized that practising physiologists are not confined to departments with the same name but are found also as clinical investigators in clinical departments, as biomedical engineers, biophysicists, pharma-

¹ Report No. 2, Medical Research Council of Canada, 1968.

cologists, anatomists, zoologists, entomologists, cellular biologists and psychologists.

SCIENTIFIC ACTIVITY IN THE UNIVERSITY

3. The advancement of science, except in theoretical areas, requires laboratory investigation. Little new can be revealed, in a field such as physiology, without modern equipment, adequate space and at least standard animal housing facilities. Much has been done in recent years, both through Federal funding of new medical schools and the persistent efforts of the Medical Research Council to raise the level of grant-in-aid support, to make working conditions and equipment equal to the demands of modern research. It will be essential, in the light of planned expansion of student enrolment in medical schools and biology departments, to maintain an adequate growth rate of such support as the staffs of Universities grow, and the graduate student cadre expands. Such a growth rate should not only maintain present standards, but also provide for improvement in support and make allowance for technological advances which open up new but more expensive research possibilities. However, the central theme of this brief is that research is done by scientists rather than by the facilities. Their ability to achieve original and penetrating findings depends on the time they are able to devote to this facet of their work.

4. A serious debate could be stated over the question of whether University based scientists, who are on the teaching staff, can presume to do quality work in the little time left after other duties have been discharged. An ideal distribution of effort (suggested for the academic physiologist in MRC Report No. 2) is 33% of the staff member's time for undergraduate teaching and 67% for everything else. In the latter category will be graduate training, research administration, committee work within

the University, extramural committee work, professional activities such as refereeing and editing manuscripts, reviewing grant applications, public relations work and attending scientific meetings. For most clinical physiologists there will be, in addition, care of patients. Some of these activities can be sidestepped, but most are ultimately essential if only to make a more efficient environment in which to do research and to ensure that public funding will continue to be adequate. The remaining time can be available for research. It is an essential feature of economical research that the scientist is not simply repeating what has already been done, or worse, trying to prove something which has just been acceptably disproved or using a completely outdated technique which could be replaced by one giving three times as much information for the same effort. These reasons alone, apart from the need to design his own study with awareness of the current frontiers of knowledge, make it mandatory that a practising scientist spend time reading current literature. There are many bibliographic devices available to provide rapid access to the titles of articles being published (e.g. Current Contents), but ultimately the selected articles must be read—at least superficially. This requires another slice of the working week. These considerations make it hard to conceive the academic scientist having more than a third of his time for "bench" research, a fraction correspondingly less for the more administratively committee scientist—who is often the more senior or previously successful one.

5. What has this to do with science policy? Clearly it is a delusion to believe that the provision of optimal equipment and space will lead to productive scientific effort in the Universities if the scientific professional staff have progressively decreasing time to use them. Inasmuch as

university scientists have responsibility for advancing their science and propagating their own kind, science policy cannot be divorced from policy determining the support and development of places of higher education.

Only since the recent emphasis on graduate student education have University authorities felt some obligation to support research actively. Funds from the University budget for direct research expenses (as opposed to support of graduate students) are still usually a negligible proportion of extramural support; graduate courses are readily approved for the calendar, but without any policy of compensating reduction in the instructor's other academic commitments. Research productivity is expected from staff members, but priority of research commitment over teaching and administrative duties must be assigned hazardingly or surreptitiously and by the academic himself. Usually research is done on "free days"; research reading is the most displacable assignment in the schedule of all but the rare intensely self-disciplined person. In an attempt to survive this situation, many an academic scientist staffs his laboratory with graduate students, technicians and post-doctoral fellows who do the research which he directs periodically from the elevated position he attained by earlier prowess. However, original research and the exploitation of serendipitous results require a continuing direct involvement and so does successful graduate student supervision. It is not suggested that the "research director" solution to the problems posed is a satisfactory one; the frequent result is that the best trained member of the team has the least contact with the realities of the research. The techniques and the future experimental design depend for their quality on those auxiliary personnel who can devote their full time to the work. How far removed is the average academic scientist, burdened with multiple distractions and concurrent commitments, from

the ideal state described by Cajal¹; "With reason, writers on logic emphasize the creative power of attention, but dwell little upon a form of attention which might be fittingly called cerebral polarization or chronic attention, that is, a permanent orientation of all faculties toward a single object of study for months or even years".

6. How effective, then, would a science policy be which provided even more support for research done in the University environment? In the writer's opinion, the return from such increased support will be seriously limited without changes in attitudes and organization within these communities of scholars. In many academic circles, research is regarded as a luxury item for which it is up to the dedicated staff member to find the time and funds. Administrators often secretly feel that research is "puttering about", but paradoxically, place research productivity high on the list of qualifications for appointment and promotion. The result, unfortunately, is that many academic physiologists ensure that some "research activity" is identified with their area, but have no special talent for the real thing. On the other hand, those who are well trained and talented are often constantly frustrated by their inability to devote the majority of their energies to this work. A logical solution is to provide academic positions for "research and graduate training" which strictly limit the permissible commitment to other academic responsibilities. This concept is realized in the Medical Research Associate and Scholar categories of M.R.C. support of personnel; it could be furthered by the establishment of Research Units—best devoted to some particular research area or problem. This is not a new idea in any sense. M.R.C. Units are common in the United Kingdom, they have been considered fully by the M.R.C. in Canada, and the principle is now policy. But few such Units exist and there is considerable opposition to

¹Ramon Y. Cajal: Precepts and Counsels on Scientific Investigation, 1951 (translation), Pacific Press, Mountain View, California.

them in physiology circles; department heads fear the potential syphoning off of their best staff members into intramural Units, and staff members who have heavy teaching commitments resent the introduction of a privileged group into their midst. At the same time, to separate such Units from the University setting could deprive the latter of its major creative element, leaving behind a passive and potentially sterile "brain without hands". It is to be stressed, also, that graduate training is as important at least as undergraduate training and not all University teachers are suited to do both. The former completes the educational process; without it the supply of scientists would dry up and, ultimately, the supply of teachers of the undergraduates. It can hardly be questioned that graduate training programs depend upon an active and sophisticated research program. It is submitted, then, that a science policy must include measures which ensure the growth of effective research environments within Universities and that the weak link in present support, however enlightened in other directions, is a failure to recognize that research or creative activity is a primary function of the University and reorganization of its structure must be undertaken to provide staff with the necessary uncommitted time to devote to this function.

7. One possible form of such reorganization could be the division of each science department into two sub-departments--one concerned mainly with undergraduate teaching and the other with research and graduate training. There would be much reaction to this; it is argued that two classes of academic citizens would result, that the teacher who does no research undergoes intellectual atrophy and has no incentive to keep his knowledge current, that good teachers are often good researchers so that the less successful researchers would possibly be the poorer teachers. But not so frequently expressed is the likelihood that many academics, whose first love really is teaching, would be satisfied to be relieved of the necessity

of doing research which they do not enjoy--and to be given full opportunity to put their best effort into high quality instruction. Also, it is not necessarily important that undergraduate course content be current in its details if the fundamentals are effectively communicated. In any case, who is more likely to have the time to keep abreast of developments of general importance over a broad field--the staff member whose principal preoccupation is teaching or his colleague whose available reading time must be devoted to the specialized literature of his research field? Finally, those who regard teaching as a "load" should not feel discriminated against, as this proper academic function would be discharged by both sub-departments but at different levels and in proportion to individual talents. Of course, such reorganization would require administrative acceptance of the equality of value of the two sub-departments in achieving the total goal of the University, part of which is that research funds should be more effectively used and warranted.

SCIENTIFIC DOCUMENTATION IN CANADA

8. It is not debatable that the application and advancement of any science depends upon selective preservation of a body of knowledge, assimilation and integration of current findings and accurate and organized communication of such a body of facts and their interpretation. This is achieved by maintaining libraries of past and current publications and by formal interaction between student and instructor; publications are, of course, only records of the data collection, analysis and interpretation of the scientists. Our national physiological community tends to rely on the textbooks, monographs, symposium reports and journals of other countries; such dependence can lead to limitations in commitment and conviction in advanced teaching, a certain remoteness from the realities of one's science

and a tendency of trainees and uncommitted students to assign a secondary role to their teachers in this country. The ready availability of good quality publications of other countries removes the necessity for our own workers to discipline themselves to the periodic "brain dusting" which follows a careful survey of the older and current literature and which inevitably leads to clearer research formulation and interpretation. A future science policy could, then, emphasize the desirability of our original workers becoming increasingly independent in the field of scientific documentation. Nationalism has, of course, no meaningful place in the significance of the scientific work itself but it can have importance in providing a competitive incentive which is harmless if it leads to increased effort. But the more important reason for these considerations is the central theme of this brief, the need to provide, by any suitable means, a greater opportunity to Canadian scientists to devote themselves to serious scientific activity—one facet of which is periodic purposeful study.

9. This firstly requires deliberate measures to provide selected scientists in Canada with the time and incentive to prepare specialized texts and monographs and to write reviews of current advances; secondly, it requires adequate subsidization of publication costs. As examples, a scholarly review article may require perusal, at least, of 500 recently published papers followed by hundreds of hours of comparison and synthesis of data organization of presentation and the details of final preparation. It is unusual for a scientist to undertake such a task unless there is some guarantee that his manuscript will be accepted for publication; the conscientious scientist is unlikely also to commit himself to preparing a review unless he can be freed from all other duties for a period of months—usually

only realized during a sabbatical year. It would greatly encourage the writing of scholarly works (other than research reports) if short-term "sabbatical leave" periods were widely sponsored and if existing publication channels were subsidized to prepare review issues and supplements. The latter has direct relevance to the Canadian Journals of Research; these are well regarded journals of good quality which are currently in financial difficulty. They have been unwilling to consider adding reviews to the present publication of research reports, or to print communications of Society meetings (in the Canadian Journal of Physiology and Pharmacology) partly due to financial limitations. It might be mentioned that *Acta Physiologica Scandinavica*, published under Swedish Government auspices, has frequent supplements in which whole Ph.D. theses are among other lengthy works, appearing. Symposia of the American Federation of Biological Societies are published regularly in Federation Proceedings; although this publication is heavily supported through advertising it is an effective medium in which many Canadians publish. Naturally, this encourages participation in U.S. and overseas symposia in preference to such integrating meetings in Canada--the publication of which is sporadic and requires extensive negotiation, usually with commercial printing houses.

THE ROLE OF GOVERNMENT IN FOSTERING
SCIENTIFIC ACTIVITY IN UNIVERSITIES

10. What should be the role of government in realizing such a redirection of University organization and activity? Many would oppose any direct governmental interference with academic evolution. But selective support of thoughtfully planned changes is always at least considered. In some directions, support would be accepted readily. NRC Journals, for example, could receive adequate subsidization for supplementary issues to contain

reviews of literature, symposium reports, and even selected theses. The publication of Canadian monographs and texts could be specially subsidized and prospective authors could be given leave-of-absence grants to prepare their material. Universities could be encouraged to add full-time research personnel to every science department, the funding to be supplementary to the usual University budget. Research Units could be selectively organized, with space and equipment provided by the government and remaining the property of it. The mechanism for allocating such funds would require careful definition, as the nature of the research to be done should not be determined by pragmatic considerations. It is a truism that fundamental advances must precede their practical application--and the former are the traditional responsibility of the University. This does not mean that applied research should be discouraged in those areas where it is a usual pre-occupation--as in the research areas of many engineering faculties, for example, or in clinical investigation laboratories. But the choice of problem should not be dictated--directly or by restrictions--it must remain the responsibility of the applicant investigator. Nothing kills research motivation faster than forcing the scientist to do work which fails to interest him and to which he is not emotionally committed by curiosity. The Medical Research Council has always pursued a very liberal policy in this regard, and it is probably safe to say that most academic physiologists would be quite content to see special programs of support of medical science administered by this body on which they have representation at all levels. However, the complexities of change in University organization also require that any new support programs be designed in consultation with relevant academic bodies--in the case in question, particularly the Councils of Graduate Schools or Faculties. At the same time, the undergraduate teaching activities of the Universities must not be undermined, willingly or inadvertently. For this reason, it is proposed that parallel development of the

research environment should be the basic guideline and it is suggested that, in the case of Physiology, the departments where this discipline is carried out be constantly informed of plans for research development.

11. Relevant to the proposed strengthening of the complement of research personnel in Universities is the supply of young physiologists. The projections of the M.R.C. Report No. 2 of increasing graduate student enrolment (from 238 in 1968 to 410 in 1973) clearly suggest that the academic market for Ph.D.'s will be saturated by 1975. Unless a new set of research positions at professional level is created by that time, good graduates with research training and specialized skills will probably be forced to accept technical positions or to teach at lower levels than in Universities. This may indeed be the time when the fundamental aspects of this and other sciences are adequately well represented in Universities and when "mission-oriented" Research Units and Institutes, devoted to solving specific problems of disease of environmental and natural causation, could be a major form of additional science support in Canada. The choice of research personnel for such Units could be aided by "streaming" of Ph.D. trainees, at some point in their program, toward a more or less applied problem. Many graduate students are initially motivated to help solve a specific medical problem, only to be frustrated by the apparently esoteric thesis project settled upon by their advisers. If science policy is likely to redirect government support of research increasingly toward applied aspects, the Universities which produce the researchers should be prepared in advance to adapt their training programs appropriately. Some flexibility could be introduced into University graduate training programs by allowing students to select either of two patterns, as envisaged in Appendix II.

SCIENCE POLICY FORMULATION

12. Science policy formulation, as suggested earlier, could be gravely unwise if it failed to include participation by University representatives, especially from Schools or Faculties of Graduate Studies. The implications of "formula financing" of Universities in Ontario are only becoming apparent now, perhaps because insufficient study by University policy makers preceded this change. Formula support of scientific research, based on value judgments by non-scientists, could influence the type and quality of the research done and hence the type and quality of graduate training. The responsible administrator of public funds in any revised support program would reasonably expect from recipients some type of formal undertaking with a defined goal. He might elect to use the "research contract" method although this is anathema to many scientists because its rigidity restricts the exploratory mind and operates against exploitation of unexpected findings. He would be obliged to decide on some means to judge the success of a particular allocation of funds. Whatever is selected as the measuring stick—number of research publications or number of monographs printed or number of research personnel recruited—will determine, to some degree, the direction of effort in Universities. The consequences of particular support programs are not always predictable but what would be the effect on teaching in Universities if one fifth of the staff were constantly away writing reviews or if full-time research positions were made so attractive by loosely defined responsibilities and various other advantages that the academic halls became deserted overnight? Clearly, close consultation with University authorities representing both graduate and undergraduate teaching organization would help to avoid unfortunate consequences of new support programs. In addition, it would seem most wise that experienced

research funding organizations such as the Medical Research Council and the Canadian Heart Association be involved in science policy formulation as well. Professional associations, such as the Canadian Physiological Society, provide media to test the subjective reaction to proposed policies and it and similar "learned societies" should at least be informed of policies under consideration. It is questionable whether such societies should be represented directly in policy formulation committees, as overlapping representation would result and it is logistically unwieldy to consolidate opinion of the whole membership on matters of detail.* In addition, such societies are often not anxious to extend their activity beyond the exchange of reports on research in their discipline.

13. Finally, little has been said about the ways in which science policy might contribute to the solution of social problems, national and international. Physiologists are not uninvolved, professionally, in these problems as they relate to health hazards and both preventive and curative health care. They are very real ones, overpopulation and water and air pollution threatening the very survival of the human species. Indeed, it is vigorously held by some that science policy should accept what is already known and take steps now to stop the presently inevitable progress toward our own destruction. But it can be argued, by those less visionary, that until Canadian science, or more specifically physiological science, has reached a stature commensurate with the size of our population or our national income (which may only be achieved when our research budget is similarly commensurate in comparison with countries like Sweden and the United Kingdom) we should concentrate on consolidating our own present and rather circumscribed effort. As has been advanced earlier, this effort in Universities is properly largely in the realm of fundamental science.

* The author of this brief takes refuge behind this consideration.

Science even in its most theoretical aspects is useful; basically its purpose is to improve the knowledge of self-maintenance of humankind. Distinction between theoretical and practical sciences and emphasis on applied research at the expense of abstract investigation may prove in the end not to be pragmatic. Applied or mission-oriented research centers should not displace fundamental research centers--as the former need the trained staff, already versed in basic facts and techniques, which the latter produce. This decade of rapid growth of Universities and explosive growth of knowledge is one of crisis for University standards, and these must be protected by avoiding too sudden an introduction of measures which might further compromise them. Science policy should, we believe, be closely interwoven with University affairs policy and the academic community will, as in the past, contribute its fair share to the solution of broader problems.

APPENDIX 1

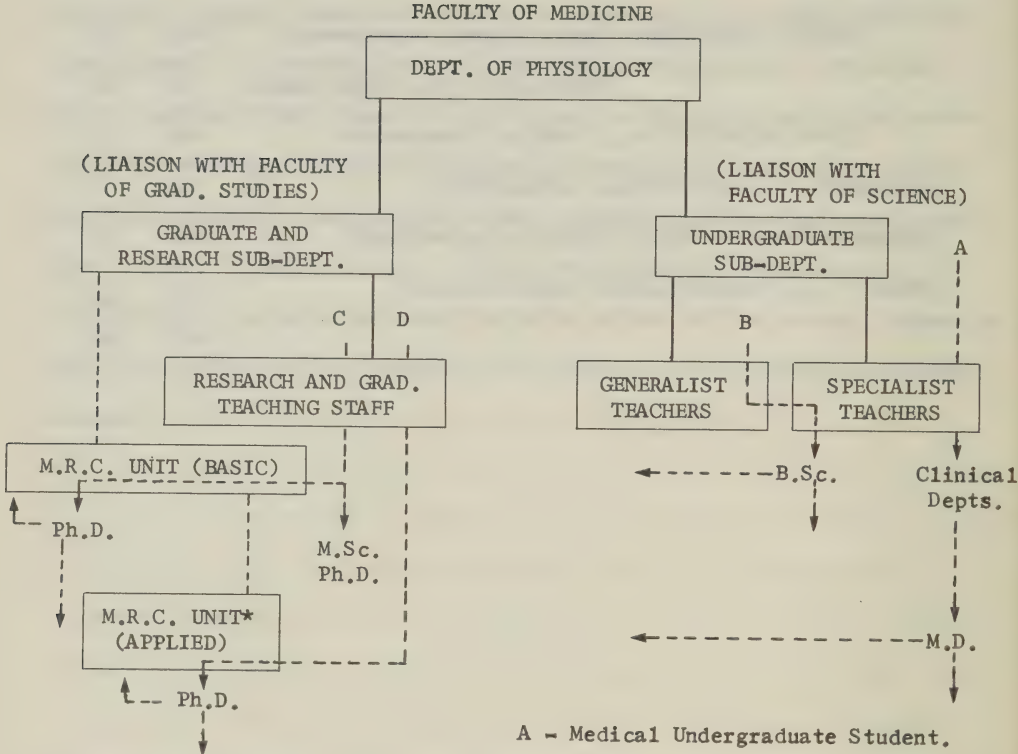
PLACE OF EMPLOYMENT - Ordinary MEMBERS, CANADIAN PHYSIOLOGICAL
SOCIETY

| | Number | % |
|---|-----------|----------|
| UNIVERSITIES | | |
| - MEDICAL FACULTIES - Basic Science Departments | 206 | 51 |
| - Clinical Science Departments | 65 | 16 |
| - OTHER FACULTIES (e.g. Biology Departments) | 42 | 11 |
| GOVERNMENT OR INSTITUTIONAL LABORATORIES | 15 | 4 |
| PHARMACEUTICAL OR OTHER INDUSTRIAL LABORATORIES | 49 | 12 |
| OTHER (e.g. Administrative organizations) | <u>26</u> | <u>6</u> |
| | 403 | 100 |

APPENDIX II

ONE POSSIBLE UNIVERSITY
REORGANIZATION with reference to training in SCIENCE

EXAMPLE: TRAINING IN PHYSIOLOGY



* e.g. Salt and Water Metabolism in Congestive Heart Failure

APPENDIX 109

*NATIONAL CANCER INSTITUTE
OF CANADA*

THE NATIONAL CANCER INSTITUTE OF CANADA

A Submission to

THE SPECIAL COMMITTEE ON SCIENCE POLICY

of

THE SENATE OF CANADA

Special Committee

THE NATIONAL CANCER INSTITUTE OF CANADA
A Submission to
THE SPECIAL COMMITTEE ON SCIENCE POLICY
of
THE SENATE OF CANADA

SUMMARY

1. The National Cancer Institute of Canada was established in 1947 on the initiative of the Minister of National Health and Welfare.
2. Its major programmes have been the support and coordination of research on cancer, the promotion of professional education about cancer, the compilation and interpretation of cancer statistics, and assistance in the coordination of provincial cancer programmes.
3. Since its creation, it has spent \$25,500,000 in pursuit of its objects. Its main sources of revenue have been the Canadian Cancer Society, with which it is affiliated, and the Federal-Provincial grants for cancer control. The latter source accounts for less than 12% of its annual income at the present time.
4. In addition to the provision of support for research programmes of research scientists now numbering at least 200, it has established full-time career positions for over 30 scientists and in cooperation with the Canadian Cancer Society, has made possible the construction of 100,000 square feet of laboratory space in six universities.
5. The Institute believes that since cancer is a threat to the attainment of the national goal of "Physical and Mental Health and High Life Expectancy", its programme is of major importance.
6. The Institute believes that its support of research should be directed primarily to universities, and that the maintenance of a broad programme in the field of cancer has been desirable.
7. The Institute believes that the voluntary health agencies have an important role in the Canadian medical research programme. In recent years, they have provided 25% of the total of funds for extramural research.
8. The Institute agrees that there should be integration of the policies of all agencies concerned with the support of medical research.

Summary -

9. It would be of advantage to the medical research programme in Canada if the Government were to enter into a matching grant programme with the voluntary agencies. Such an arrangement would also be of advantage to the Government in that its investment in this form would have a two-or-three-fold yield in terms of research effort.
10. The Institute looks forward to continued expansion of its programme.

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Special Committee

THE NATIONAL CANCER INSTITUTE OF CANADA

A Submission to

THE SPECIAL COMMITTEE ON SCIENCE POLICY

of

THE SENATE OF CANADA

Introduction

1. The National Cancer Institute of Canada is grateful for this opportunity to appear before the Special Committee on Science Policy of the Senate of Canada.

History, Objectives, Membership

2. The Institute was created in 1947 as a result of the initiative of the Honourable Paul Martin, Minister of National Health and Welfare in convening a conference of lay and professional persons concerned with the problem of cancer. As set forth in its Letters Patent, its objects are -

- (a) To coordinate and correlate the efforts of individuals and organized bodies with the view to reducing the morbidity and mortality from cancer in Canada,
- (b) To aid in establishing and maintaining or to establish and maintain fundamental research activities in the field of cancer,
- (c) To assist in the training of prospective scientists who may be interested in the field of cancer research by the award of fellowships for that purpose,
- (d) To make grants to, lend money to, or guarantee the contracts or otherwise assist any corporations, societies, associations, partnerships, agencies, organizations, or individuals who are engaged in activities which may be usefully carried on in conjunction with the activity of the Institute and or which may provide aid to the Institute in the attainment of its objectives,
- (e) To collect, assess and disseminate scientific knowledge and material relating to cancer,
- (f) To provide assistance, financial or otherwise, for any programme of cancer education either lay or professional,
- (g) To obtain money by way of public appeal or otherwise, and to receive gifts, bequests and donations of property, both real and personal,
- (h) To operate and maintain facilities for the purpose of treatment and research,
- (i) To assist in the examination of any method of cancer prevention, treatment or cure when so requested by any dominion or provincial governmental body.

3. The membership of the Institute which totals 40 is set forth in the By-laws. Fourteen are representative members who are nominated by the following agencies -

| | |
|--|---|
| Canadian Cancer Society----- | 6 |
| Medical Research Council of Canada----- | 1 |
| Royal College of Physicians and Surgeons of Canada----- | 1 |
| Canadian Medical Association----- | 1 |
| Association des Médecins de langue Française du Canada----- | 1 |
| Department of National Health and Welfare----- | 1 |
| The Association of Universities and Colleges of Canada----- | 1 |
| Canadian Dental Association----- | 1 |
| Canadian Federation of Biological Societies----- | 1 |

The remaining 26 members are members at large. The By-laws state that "any person who in the opinion of the Board will by active participation in the Institute, assist in the attainment of its objectives shall be eligible for appointment as aforesaid. At least one-third of the members shall be qualified in sciences related to or allied to the medical profession". The current membership of the Institute is set forth in Appendix A.

4. The major programmes of the Institute have been the support and coordination of research on cancer, the promotion of professional education about cancer, the compilation and interpretation of cancer statistics and assistance in the coordination of provincial cancer control programmes. Under an agreement with the Canadian Cancer Society, the Institute does not make a public appeal for funds, and it does not operate or maintain facilities for treatment or research as these services are within the responsibility of the provincial treatment agencies or the universities respectively.

5. The main sources of the Institute's income have been the Canadian Cancer Society, the Federal-Provincial Grants for Cancer Control and the King George V Silver Jubilee Cancer Fund. Graphs which present our experience for the years 1947 to March 31, 1968 are attached as Appendix B and C. They show the extent of the support received and how these funds were disbursed. During the year ending March 31, 1969 the Institute will spend approximately \$3,750,000 in pursuit of its objectives.

6. In the period covered by the Table, 19.7% of the total income came from the Government, but the support from this source has remained at a relatively fixed level with the result that its proportion of the annual income has fallen from 70% in 1948-49 to less than 12% in 1967-68.

Special Committee

Programme

7. Approximately 90% of the budget is spent on research and of this, 95% is awarded as grants for research. The balance is used for the support of training in research. To ensure that the funds are spent wisely and effectively, all applications for support are reviewed by Grants Panels, by a Research Advisory Group and when indicated, by outside referees. The membership of these Panels is drawn from the ranks of senior research scientists who have established their competence and have demonstrated their interest in the problem of cancer. It is worthy of note that only 4% of the budget is required to meet the costs of administration.

8. The product of 22 years of activity can be summarized by saying that the Institute has been instrumental in the creation of a broad and well-coordinated programme of fundamental and clinical cancer research. As is documented by the growth of its investment in the support of training, it has contributed to a reversal or at least to a slowing of the movement of talented young Canadians to other countries by supporting the training of promising young scientists from the day of their graduation to the post-doctoral level and by the establishment, in cooperation with the universities, of full-time career appointments for over thirty research scientists. With financial support from the Canadian Cancer Society, capital grants of a total value of \$4,500,000 have enabled six universities to create and equip 100,000 square feet of laboratory space, and at the present time, the Institute's programme is supporting the research efforts of approximately 200 scientists. A copy of the most recent Annual Report is included as Appendix D.

9. Its willingness to experiment is evident by the fact that it was the first organization supporting medical research in Canada to establish the type of appointment now referred to as a research scholarship, the first to grant funds for the creation of full-time positions in universities, and the first to contribute capital funds for the construction of research facilities.

10. As has already been mentioned, the Institute was created by action of the Federal Government. This in part explains the close association it has had with its departments and agencies. Representatives of the Institute have served

the Government in the following areas -

Defence Research Board - Panel on Radiation Protection
and Treatment
Dominion Bureau of Statistics
External Affairs - Canadian Economic Development Agency
Medical Research Council
National Health and Welfare - Food & Drug Directorate
(Health Services Branch - Radiation Protection Division)
National Research Council - Associate Committee on Radiobiology

11. On the international level, representatives of the Institute have been advisers to the National Institutes of Health in the United States, have served on a scientific council which was advisory to the Government of France on the matter of the creation of the International Agency for Cancer Research, and have accepted appointments on expert committees and commissions of the International Union Against Cancer.

Comments and Recommendations

12. The foregoing catalogue of activities has been presented to establish the credibility of the Institute as a witness competent to comment on the cancer research activities of this country.

13. Since this Committee has expressed an interest in goals and priorities, one may begin by stating that the Institute's primary and continuing objective is to use all means at its disposal to increase the scope and effectiveness of the attack on cancer. The annual mortality caused by this group of diseases in Canada is sufficiently high to give this goal high priority. If it is true that up to 80% of cancer is preventable, cancer is truly a problem in human ecology, and the threat of cancer is a threat to the attainment of one of the six national goals as defined by the Science Council namely "Physical and Mental Health and High Life Expectancy".

14. The Institute shares the belief expressed to you by others including representatives of the Canada Council and of the Science Council that research carried out in educational institutions enables them to recruit, to train and to retain first-class scientists; and that the fruits of research in other countries will be used more effectively if research is going on in the same field in Canada. It is for these reasons that its grants for research have been awarded almost

exclusively to scientists who hold academic appointments in a university and that the Institute has supported a broad programme.

15. We believe that the voluntary agencies have an important role to play in fostering research in areas of concern in the field of health. They provide a mechanism not available to governmental agencies through which the citizen becomes directly and personally involved in the encouragement of scientific activity in this country. Comments on their importance are set forth in the presentation of the Chairman of the Medical Research Council and in the Council's report on Canadian Medical Research. The very existence of such agencies constitute expressions of public opinion about the importance of the problems they are attacking and they help to answer the question raised by others on how one "writes criteria and establishes relative importance". The existence of multiple, strong independent sources of research support also avoids the dangers inherent in a monolithic form of support.

16. The voluntary agencies provide approximately 25% of the total funds for extramural support of research in universities. In a report on this matter which was submitted by the Institute to the Science Secretariat last year, it was stated "Reference to the Minutes of successive meetings of the Interdepartmental Medical Research Coordinating Group shows that during the past three years the total annual amount of support for Medical Research in Canada from all sources has grown from \$20,000,000 to \$35,000,000. The most significant change in the support from Government sources has been the growth of the budget of the Medical Research Council. During this period, the support from all governmental sources (Department of Veterans Affairs, National Research Council, Department of National Health and Welfare, Medical Research Council) has amounted to approximately 75% of the total each year. The balance has come from a total of 14 voluntary agencies (of which the National Cancer Institute is the largest as measured by its research budget), and in a dwindling stream from American agencies, both Governmental and non-Governmental". As has already been documented, the agencies have shown a willingness to use their flexibility to experiment with new approaches to research support.

17. We share with others a belief in the importance of integration of the planning of all agencies concerned with the support of medical research. The

mechanism for such collaboration is already in existence. For some years, the Institute has participated as a member of an informal coordinating group sponsored by the Government agencies concerned with health research.

18. With the advent of the Medical Research Council and the availability of additional funds, the Institute is re-examining its policy with respect to research support. The review has been forced on it also by a forecast of its budget for the period ending in March 1973, which is shown in a table and a graph attached as Appendices E and F respectively. It is to be noted that the call upon the Canadian Cancer Society for support will increase very substantially, but the increase in funds available from that source will be limited by the Society's fund-raising experience and unless assistance from governmental sources is increased, the Institute will be forced to curtail its programme. One effect of this curtailment will be the postponement or cancellation of plans to create additional cancer research units on the campuses of other universities. For the year 1969-70, the Institute has already found it necessary to turn down applications of a total value of \$250,000 which were approved by its advisers.

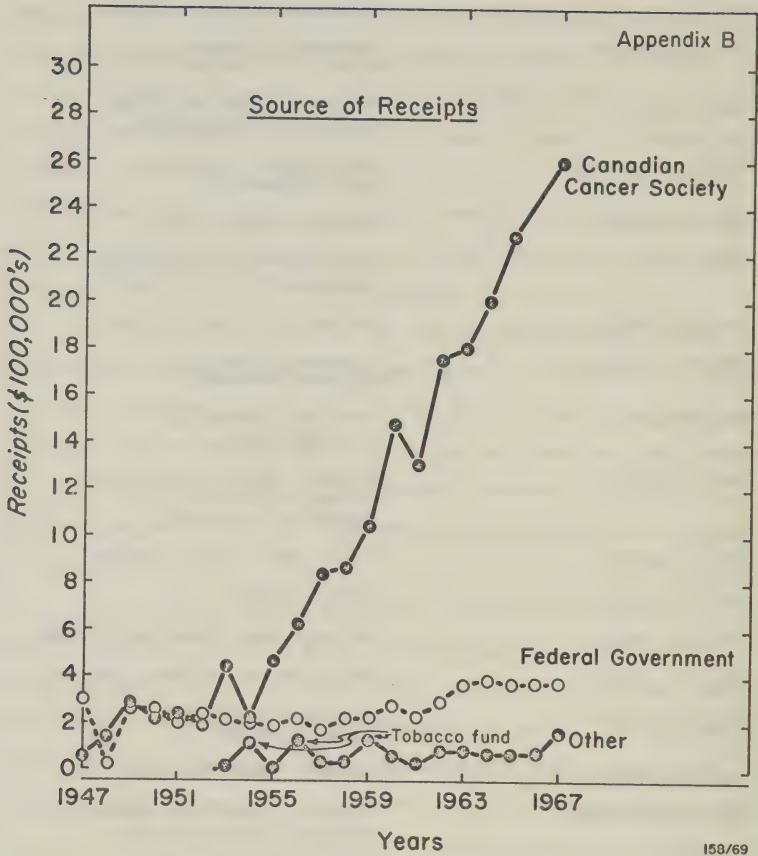
19. The Minister of National Health and Welfare has described the difficulties his department faces in determining appropriate levels of support which might be made available to voluntary agencies by the Government. The Institute has suggested that the support from the Department might be related to the level of support received by that agency from the public. As an example, it was suggested that in the first year of such an arrangement, the Department might provide a grant equal to 15% of the total received from voluntary subscribers. This could be increased in annual steps until the support from Government sources was at parity with the support received from the public. Such a formula which invokes the principle of matching grants has been successful in the stimulation of programmes whose costs have been shared by the Federal and Provincial Government. Applied to voluntary agencies it would spur them to increase their own campaign activities; and it should be of interest to the government that the implementation of this scheme would guarantee a two-or-three-fold return on the dollar it invested insofar as increased research effort is concerned.

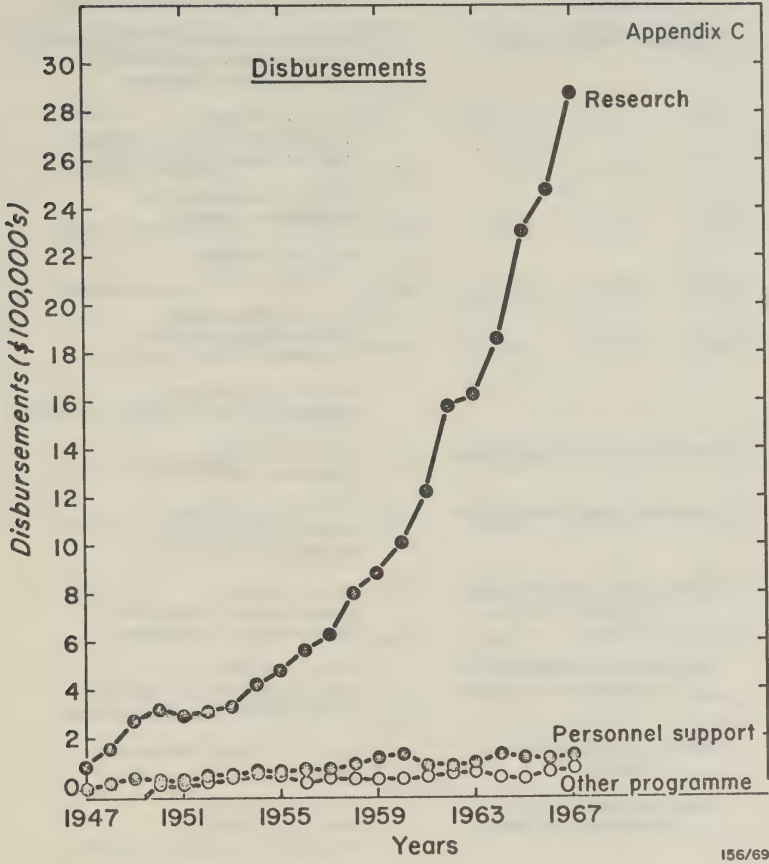
20. Whether or not the Government accepts this recommendation, it is probable that an increasing proportion of the Institute's budget will be devoted to the support of research units in which there are groups of full-time investigators who share and reflect the interests of a research director. The size of these groups is considered to be large enough to form critical masses which will generate new ideas and constructive criticisms of its members' programmes.
21. In Canada, the amount of effort in a number of areas having to do with cancer is far from satisfactory. Although laboratory research is growing at a satisfactory rate, the same cannot be said for clinical research in spite of efforts to increase the amount of research on human cancer. Furthermore, the quality of clinical research proposals is frequently inferior to that of proposals from those trained in the basic sciences.
22. A second problem area is in the field of epidemiological research. The shortage of trained epidemiologists and the lack of epidemiological research is a matter of concern in many areas, and is a source of concern to those whose interest is in the problem of cancer. If as has been suggested, a high proportion of cancer is preventable, it is of greatest importance that careful epidemiological studies be launched so that the environmental factor or factors may be discovered.
23. The standard of medical research in a country is reflected in the quality of patient care. Canadians by contributing to the Canadian Cancer Society and through it to the National Cancer Institute of Canada, have made a major contribution to the development of research on cancer. They have made possible the initiation of a programme which is now growing so rapidly that support from the Government must be provided if it is to maintain its impetus.
24. In the field of cancer research as in other fields of scientific endeavour, Canada's contributions to the world effort is not commensurate with its wealth and its potential. This great country has a moral responsibility to do much more. The Institute hopes to be able to participate in such an expansion of effort.

Appendix A

MEMBERS AT LARGE

| | |
|---------------------|--|
| Dr. M.L. Barr | Professor of Anatomy University of Western Ontario |
| Dr. W.G. Beattie | Department of Surgery Ottawa Civic Hospital |
| Dr. R.W. Begg | Principal of Saskatoon Campus University of Saskatchewan |
| Dr. E.H. Botterell | Dean, Faculty of Medicine Queen's University |
| Dr. C.C. Burkell | Saskatoon Cancer Clinic |
| Dr. D.H. Copp | Head, Department of Physiology University of British Columbia |
| Dr. C.H. Crosby | Medical Arts Clinic - Regina |
| Dr. R.C. Dickson | Professor of Medicine Dalhousie University |
| Dr. C. Fortier | Professor of Physiology Laval University |
| Dr. A. Frappier | Director, Institute of Micro- biology and Hygiene Université de Montréal |
| Dr. R. Gaudry | Rector, Université de Montréal |
| Dr. G.E. Hall | Orillia, Ontario |
| Dr. L.G. Israels | Manitoba Cancer Foundation, Winnipeg |
| Dr. H.E. Johns | Ontario Cancer Institute, Toronto |
| Dr. C.P. Leblond | Department of Anatomy McGill University |
| Dr. M.R. MacCharles | Manitoba Clinic, Winnipeg |
| Mr. K.R. MacGregor | President, Mutual Life Assurance Company of Canada, Waterloo |
| Dr. W.C. MacKenzie | Dean, Faculty of Medicine University of Alberta |
| Dr. M. McGregor | Dean, Faculty of Medicine McGill University |
| Dr. G.W.O. Moss | Deputy Medical Officer of Health Toronto |
| Dr. R.A. Mustard | Medical Arts Building, Toronto |
| Dr. R.J. Walton | Director, Manitoba Cancer Foundation Winnipeg |
| Dr. O.H. Warwick | Vice-President, Health Sciences University of Western Ontario |
| Dr. T.A. Watson | Director, Ontario Cancer Foundation London Clinic |
| Dr. D. Waugh | Head, Department of Pathology Dalhousie University |





Special Committee

REPRESENTATIVE MEMBERS

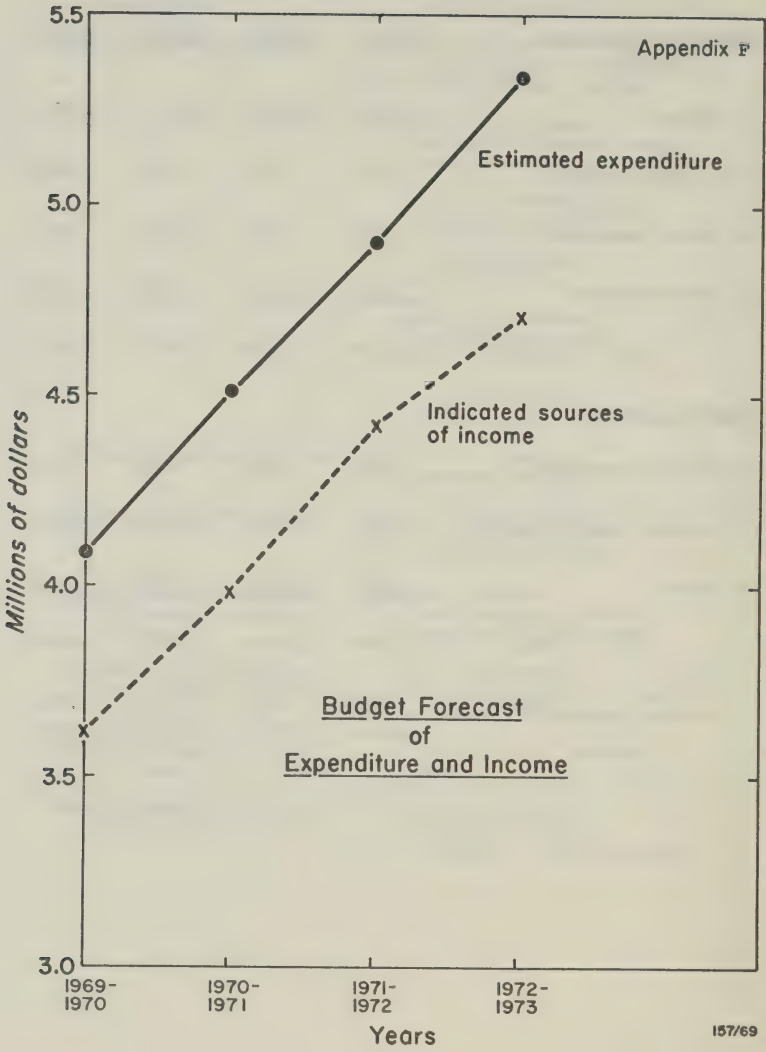
| | |
|--|--|
| Royal College of Physicians and Surgeons | Dr. I.W.D. Henderson Montreal General Hospital |
| Department of National Health and Welfare | Dr. C.G. Rand Health Services Branch, Ottawa |
| Canadian Cancer Society | Mr. P.M. Draper Vice-President and Secretary Canron Limited, Montreal |
| | Mr. G.C. Hitchman Deputy Chief General Manager Bank of Nova Scotia, Toronto |
| | Mr. W.E. Huckvale, Q.C. Lethbridge, Alberta |
| | Mr. D.F. MacGowan St. John, N.B. |
| | Mr. F.F. McEachren Public Relations Dept. T. Eaton Co. Ltd. Toronto |
| | Mr. R.A. Sanderson Vancouver, B.C. |
| Canadian Medical Association | Dr. W.A. Maclean Edmonton, Alberta |
| Canadian Dental Association | Dr. C.H.M. Williams Faculty of Dentistry University of Toronto |
| L'Association des Médecins de Langue Française du Canada | Dr. M. LeClair Dean, Faculty of Medicine University of Sherbrooke |
| Association of Universities and Colleges of Canada | Dr. R.C. Harrison Head, Department of Surgery University of British Columbia |
| Medical Research Council of Canada | Dr. G.M. Brown, Chairman Ottawa |
| Canadian Federation of Biological Societies | Dr. A.H. Neufeld Faculty of Medicine University of Western Ontario |

Appendix E

BUDGET FORECAST

THE NATIONAL CANCER INSTITUTE OF CANADA

| <u>Estimated Expenditures</u> (\$000's) | <u>1969-70</u> | <u>1970-71</u> | <u>1971-72</u> | <u>1972-73</u> |
|--|----------------|----------------|----------------|----------------|
| 1. Research | 3,611.5 | 4,005.0 | 4,347.5 | 4,767.0 |
| 2. Personnel Support | 255.0 | 250.0 | 275.0 | 300.0 |
| 3. Other Programmes | 106.1 | 120.1 | 123.1 | 138.1 |
| 4. Administration | <u>131.2</u> | <u>135.7</u> | <u>139.65</u> | <u>145.7</u> |
| Total | 4,073.8 | 4,510.8 | 4,885.25 | 5,350.8 |
| <u>Sources of Income</u> | | | | |
| 1. Federal Government | 350.0 | 350.0 | 350.0 | 350.0 |
| 2. Canadian Cancer Society | 3,100.0 | 3,500.0 | 3,900.0 | 4,200.0 |
| 3. Other | <u>135.0</u> | <u>140.0</u> | <u>140.0</u> | <u>140.0</u> |
| Total | 3,585.0 | 3,990.0 | 4,390.0 | 4,690.0 |
| Deficit | <u>488.8</u> | <u>520.8</u> | <u>495.25</u> | <u>660.8</u> |



APPENDIX 110

B R I E F

to the

SPECIAL COMMITTEE ON SCIENCE POLICY

of the

SENATE OF CANADA

from the Council of

THE CANADIAN ASSOCIATION OF ANATOMISTS

| | |
|-------------------|---|
| PRESIDENT: | Dr. Keith L. Moore* Professor of Anatomy and Head of the Department Faculty of Medicine The University of Manitoba Winnipeg 3, Manitoba. |
| SECRETARY: | Dr. William Webber Associate Professor of Anatomy Faculty of Medicine University of British Columbia Vancouver 8, B.C. |

*Curriculum Vitae Attached

Special Committee

1.1 The Canadian Association of Anatomists - Association Canadienne des Anatomistes was formed in 1956 to advance knowledge of anatomy and to represent the anatomical sciences in Canada. It consists of 237 members, most of whom are in anatomy departments in medical, dental and veterinary medical schools, but anatomists in zoology and biology departments of the Universities and in research institutes are well represented. All elected members are professionally qualified, M.D. and/or Ph.D., or D.V.M. and have made significant contributions to the development of the science of anatomy.

1.2 Anatomists' special needs are often lost in reports^{1,2} on the need for increased funds for research and for the training of teacher-scientists. The Council of our Association therefore felt that we should accept the invitation of the Special Committee on Science Policy to submit a Brief so that we could briefly point out our rather special needs.

1.3 SUMMARY OF MAIN CONCLUSIONS & RECOMMENDATIONS

- (a) The space available for anatomical research ranges from the woefully¹ inadequate in some Universities to the barely adequate in most others¹, partly because of increased teaching space required in recent years for paramedical students.

Recommendation - Increase funds for provision of additional space in Universities for research.

- (b) There is a shortage of competent teacher-scientists of anatomical science. The present studentship programmes of the Medical Research Council and the National Research Council simply do not meet the requirements of our training programmes that will enable such persons to be trained in the numbers required.

Recommendation - Special training grants should be made by the Medical Research Council for the development of teacher-scientists in the anatomical sciences.

- (c) Good job applicants and members of staff are attracted to other countries, especially to the United States, where support for specialized anatomical research is easier to obtain. The situation is not as serious as it was two years ago but it still exists.

Recommendation - Increase funds to the Medical Research Council and the National Research Council for research.

2.1 Anatomy in Relation to Medicine, Dentistry, Veterinary Medicine, Biology,
Zoology and Paramedical Sciences

Anatomy is the branch of science which deals with the macroscopic and microscopic structure of living things, with the way in which structure is related to function, and with the processes by which structure evolved in the species and developed in the individual. Without a knowledge of anatomical structure, physiological function and the processes of biochemistry become abstractions with no obvious relevance to the body.

2.2 Forming as it does the basis for so many biological and health disciplines, it is not surprising that research carried out by anatomists varies widely. Many people, outside the field, equate anatomy with gross (macroscopic) anatomy which, although important, has relatively little to offer nowadays in the way of research opportunities. Because of this misconception, anatomy often carries the connotation of a discipline that is necessary in teaching medical, dental, veterinarian, biology and various paramedical students, but is static and unattractive in comparison with the younger basic health sciences. In recent years the attitude toward gross anatomy has become more dynamic and functional, utilizing such specialized techniques as electromyography in research. Of significance also is the impact of research in the other subdisciplines of anatomy (histology, cytology, embryology and neuroanatomy). Each has ramifications of first importance in present day anatomical research.

2.3 As stated previously, the research interests of anatomists are broad and now show commendable interdisciplinary approaches; to illustrate this, a list follows:

HIGHLIGHTS OF CURRENT ANATOMICAL RESEARCH IN
CANADA

3.1 CELL BIOLOGY

Research on the sites and timing of intracellular synthesis of enzymic and other proteins, using isotopes and radioautography (with both light and electron microscopy) has had an important influence on making histology and cytology dynamic sciences. The information that has been obtained would have eluded strictly biochemical techniques.

3.2 ELECTROMYOGRAPHY

The precise role of certain muscles in movements in which they participate has been established. The cortical or voluntary control of single motor units in muscles has been demonstrated objectively, together with differences from one person to another. This research has an important bearing on the design and use of sophisticated prostheses for amputees.

3.3 HISTOPHYSIOLOGY OF BONE

The role of osteocytes and of cementocytes is now better understood and significant contributions have been made to our knowledge of the role of hormones, e.g. parathormone and calcitonin, on bone deposition and resorption. More is now known of the role of certain enzymes in these processes.

3.4 CYTOGENETICS

The discovery of the sex chromatin by Canadian anatomists doing basic cytological research was followed by the development of a buccal smear test which has proved to be a valuable clinical aid widely used in the investigation of sex anomalies. Hitherto unknown sex chromosome abnormalities have been discovered and related to clinical syndromes. This work has a close bearing on certain types of mental retardation and has been conducted in various Canadian universities.

The demonstration that at least 20 per cent of human embryos that succumb do so because of numerical chromosome errors was a recent major Canadian contribution that has attracted wide interest, and has now been extended to intersexuality and other forms of abnormal development in animals.

3.5 THYROID HISTOPHYSIOLOGY

As a result of recent research, we have new knowledge on the kinetics of the thyroid gland; this applies especially to the metabolism of iodine in the follicles, the sites of synthesis of the protein moiety of thyroglobulin, and the site of iodination of thyroglobulin in the follicle.

3.6 SPERMATOGENESIS AND INFERTILITY

Research on spermatogenesis is remarkable for its discriminating attention to detail in this renewing and differentiating cell population. In addition to its important contribution to basic knowledge, the work is useful to those involved in problems of infertility in animals as well as in humans.

3.7 RADIOAUTOGRAPHY AND CELL METABOLISM

Canadian anatomists pioneered in the technique of radioautography and are still adding refinements to improve the precision and reliability of the method, for use with the electron microscope, as well as the light microscope. These procedures continue to be of inestimable value in studies on cell metabolism, cell renewal, cell differentiation, etc.

The identification of mitotic cells by radioautography after chromosomal incorporation of tritiated thymidine, has been another factor in creating a dynamic histology, by establishing sequences of cell renewal and migration in various tissues.

3.8 HISTOPHYSIOLOGY IN RELATION TO HYPERTENSION AND AGING

Research on sodium and potassium metabolism at the cellular level is an important contribution, and a somewhat unusual one for the anatomical sciences. This work has notably increased our understanding of ion transport processes and endocrine regulation of salt and water balance. The research is closely relevant to the pressing problem of blood pressure regulation and hypertension and is applicable to certain aspects of aging.

3.9 IMMUNOBIOLOGY

Antibodies that are toxic to cells of many animal species and some bacteria have been discovered in human serum; they appear during the third week of life and are macroglobulins. This finding is one of considerable importance to all using tissue culture methods.

3.10 NEUROANATOMY

The use of recently introduced neurohistological techniques, supported at

times by electrical recording methods, has added to our knowledge of connections between various parts of the brain and thereby to a better understanding of the functions of the brain.

3.11 FINE STRUCTURE

An important contribution has been the discovery of microtubules that occur in virtually all cells, establishing continuity between the plasma membrane and cytoplasmic organelles. The electron microscope is now another common research tool of anatomists.

3.12 CYTOLOGY

Cells have been shown to contain a "cell web" beneath the plasma membrane which probably serves structural purposes and a "cell coat" rich in carbohydrates on the outer surface of the plasma membrane. This illustrates that much has still to be learned about the basic structure and function of the body.

3.13 EXPERIMENTAL HISTOPATHOLOGY

Much is now known of cellular and other changes that are precipitated by magnesium-deficiency in food intake. Liberation of histamine by mast cells was shown to be an important aspect of the sequence of events.

3.14 CANCER RESEARCH

Of importance are recent contributions to our knowledge of stem cells and cytological changes during the acquisition of malignant properties of the nature and properties of cell surfaces in relation to invasiveness and metastases, and of mitotic rates in malignant tissues as compared with the antecedent normal tissue.

3.15 ATHEROSCLEROSIS

The observation that alfalfa contains an ingredient that when fed to rabbits prevents the passage of cholesterol through the intestinal epithelium into the blood and its deposition as atherosclerosis is an important finding that should be studied further.

3.16 X-RAY MICROSCOPY

Few investigators anywhere are skilled in the use of X-ray microscopy or

microradiography, but some in Canada have added to our knowledge of the blood supply of a number of tissues, including nervous tissue and the peridental membrane.

3.17 TERATOLOGY

Important contributions have recently been made to our knowledge of the teratogenic effects of drugs on embryological development.

3.18 PHYSICAL ANTHROPOLOGY

The studies on skeletal remains in a Mexico valley, dating as far back as 12,000 years ago, and their interpretation in the context of archeological information is research of a high order.

4.1 PRESENT FACILITIES AND NEEDS OF ANATOMISTS

The present facilities of anatomy departments and the plans for the next five years vary greatly from one University to another, however, there are some generalizations that can be made. As stated at the outset, the space available for anatomical research ranges from inadequate in some to barely adequate in most. Across the country the size of medical and paramedical classes is increasing and there are more and more teaching commitments to students in faculties other than medicine. This has caused a shortage of competent teaching staff. The shortage of persons trained in some aspects of anatomical science makes it difficult to see how present vacancies, and the large number that will exist in the next few years, can be filled. In recent years many positions have been filled by graduates of other countries, a situation which even if it was felt to be desirable, cannot be expected to continue.

4.2 To remedy this undesirable situation, we urge support from the Special Committee on Science Policy for our request for adequate space to meet the teaching and research requirements of the additional staff necessary to teach the increasing number of students in the health sciences, and to accommodate the increased number of graduate students that must be trained as teacher-scientists in the anatomical field.

4.3 In the last five years there has been increased training of graduate students

in anatomy departments made possible by increased support from the Medical Research Council and the National Research Council. This support, however, must be greatly increased if the required number of young people are to be trained in anatomy, and if young researchers especially are to be encouraged to pursue their research and teaching careers in Canada. At present, good applicants for graduate training or for openings on the teaching staff are being attracted to other disciplines or to other countries where funds are easier to obtain for research and funds for training students are readily available. Too frequently anatomists, especially those just embarking on a research project, are told that although their work is good and should be adequately supported, sufficient funds are not available. This announcement is particularly disheartening to beginning scientists eager to establish themselves in research and to make their contribution to knowledge. Too frequently they accept attractive offers from U.S. research institutions or University departments. The Association of Canadian Medical Colleges receives a grant from the Department of Manpower and Immigration to keep a record of graduates of Canadian medical schools working in the U.S., and to attempt to attract them back home. Surely it would be better to improve research and teaching conditions in Canada so they will not leave in the first place.

4.4. We believe that it would be helpful if departments were given funds, as are Deans, to be used at their discretion for the encouragement of research and the training of graduate students. Too often, applications for graduate study are received when supporting funds are not available and it is sometimes months before the fate of a grant application is known. Consequently, good students, with a primary interest in anatomy, are often lost because they are able to obtain firm commitments elsewhere. We have also found that the present grant-in-aid system alone inhibits to some extent truly imaginative research and favours more routine work, likely to receive grant support. Funds available to explore a new lead without delay, to guarantee student support, would be in the interests of more rapid progress in research and in the training of teacher-scientists. Similarly, a modest amount of uncommitted funds would allow a junior investigator to

carry out a pilot project in order to determine whether a formal grant application should be made or not. In the long run, money would likely be saved.

5.1

REFERENCES

- ¹Canadian Medical Research : Survey and Outlook, A Report to the Medical Research Council of Canada. MRC Report No. 2, September 1968. Medical Research Council, Ottawa 7, Canada.
- ²Medical Research in Canada. An Analysis of Immediate and Future Needs. 1965. The Woods-Gordon & Co. Brief.

APPENDIX 111

BRIEF SUBMITTED TO
THE SENATE SPECIAL COMMITTEE ON
SCIENCE POLICY
BY
THE ASSOCIATION OF CHAIRMEN OF
CANADIAN DEPARTMENTS OF PATHOLOGY
(Medical Schools of Canada)

February 11th, 1969

EDUCATIONAL, RESEARCH AND TRAINING REQUIREMENTS OF ACADEMIC
DEPARTMENTS OF PATHOLOGY
IN ONTARIO

Prepared by

| | |
|----------------|-------------------------------|
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| Desmond Magner | University of Ottawa |
| J.F. Mustard | McMaster University |
| A.C. Ritchie | University of Toronto |
| A.C. Wallace | University of Western Ontario |

Edited by

A.C. Ritchie

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I. PREFACE

The Brief was prepared by the Chairmen of the Departments of Pathology of the five medical schools in Ontario. A draft was circulated to the Chairmen of all Departments of Pathology in the medical schools of Canada, and was discussed at the meeting of the Chairmen of the Departments held in Vancouver in January, 1969. It was agreed that though some aspects of the Brief were relevant only to Ontario, or referred to matters which were dealt with differently in other provinces, that the general account of the work and needs of the departments of pathology given in the Brief were applicable across Canada. It was further agreed that the Brief should be submitted on behalf of the Association of Chairmen of Canadian Departments of Pathology to the Senate Special Committee on Science Policy.

The Brief stresses the close inter-relationship between clinical responsibilities, teaching duties, and research work which exists in departments of pathology. It also stresses the urgent need in all aspects of pathology to train more staff if we are to meet the demands of the immediate future.

The recommendations are expressed in general terms.

The Chairmen of the departments of pathology in Ontario hope now to proceed to gather the detailed information necessary to put forward more detailed proposals.

II. DEFINITIONS

In this Brief the term "undergraduate student" is used to describe those proceeding to a degree such as M.D. or D.D.S. The term "postgraduate student" describes men training in one of the specialties of medicine, working as a resident or fellow for a qualification such as F.R.C.P.(C) or C.R.C.P.(C). The term "graduate student" describes those working for a higher academic qualification such as M.Sc. or Ph.D.

The term "Pathology" is used in a wide sense to embrace all aspects of the discipline. Clinical pathology is taken to include all aspects of laboratory medicine, anatomical pathology (autopsy work, surgical pathology and cytopathology), haematological pathology, microbiology, chemical pathology, nuclear medicine, cytogenetics, and so on. Experimental pathology and didactic pathology are interpreted broadly as the sciences concerned with the nature, causes, development, and effects of disease.

Different universities organize pathology in different ways. In some, a single department is responsible for all aspects of the subject, clinical, didactic and investigational. McMaster

has a department of this kind. In others, the work is divided among several departments. In Toronto, for example, there are departments of "Pathology", responsible for anatomical pathology and haematological pathology, "Pathological Chemistry", responsible for chemical pathology, and "Bacteriology", responsible for microbiology. The relationship between the pathologists appointed by the university and those working primarily in the teaching hospitals also varies from university to university. In this Brief, these local peculiarities of organization will be ignored. In discussing pathology we will consider the total needs of the discipline, and in speaking of a department of pathology we will assume that the department is responsible for all aspects of the subject.

III. SUMMARY

This Brief sets out the responsibilities and needs of the academic departments of pathology in Ontario.

In general, the work of the departments of pathology can be divided into three phases, clinical pathology, teaching and investigation. These three aspects of the work cannot be sharply distinguished, representing overlapping areas rather than well defined segments. They are very closely interdigitated, and each reacts in a major way on the others. All must be developed in concert.

The work of the departments of pathology has been greatly extended and complicated by the introduction of the many new methods of biological investigation.

In clinical pathology, there are very major weaknesses in several areas. Chemical pathology, haematological pathology and microbiology are particularly to be mentioned. More staff and facilities are urgently needed in these and other areas. In clinical pathology too, the emergence of narrow subspecialties in pathology increases greatly the demands on the staff, necessitating increases in the size of the staff, and demanding

men who have had special training. Units in forensic pathology are urgently required.

The establishment of regional laboratory services in Ontario is desirable. In each region, the central reference laboratories should be established in university centres, and should be fully integrated with the academic departments of pathology and their teaching hospitals. An appropriate system of computerization should permit easy exchange of information between regions.

To maintain the quality of undergraduate teaching, more staff is needed. At present, the time required cannot be spared from other tasks. Many of the new staff men appointed should be active in research, increasing the number of aspects of pathology being investigated in each department. It is particularly important to develop programmes to train these experimental pathologists needed to develop undergraduate instruction. Few such programmes now exist.

Postgraduate training programmes must be greatly expanded if we are to meet the needs of the province and country for pathologists. There is a severe shortage of men in all aspects of pathology, and our present programmes are insufficient to

remedy the deficit. The programmes themselves must be considerably improved, and new programmes must be introduced to take advantage of the new kinds of specialization in pathology now permitted by the Royal College of Physicians and Surgeons of Canada. Again, more men and more facilities are needed. Appropriate arrangements for paying the men in training are also required.

Graduate programmes need expansion in all departments of pathology. Fundamental research, clinical investigation, and developmental research all need expansion, all needing more staff and more facilities. Funds to support graduate students are required, particularly for those embarked on a combined programme of training in clinical pathology and research. Such men will be the experimental pathologists from which we can draw our teachers in the future.

Continuing education for pathologists and other physicians in practice must be expanded. The quality and extent of the programmes for training laboratory technicians and other para-medical personnel must also be improved.

IV. INTRODUCTION

The Departments of Pathology in the Faculties of Medicine in Ontario are faced with several problems primarily related to personnel and facilities which must be solved if effective scientific, educational and clinical programmes are to be developed in those areas generally considered as being within the discipline of pathology.

Historically, academic pathology has been concerned with the scientific basis of disease. Departments of pathology investigated the causes and effects of disease, taught this knowledge to undergraduate, postgraduate and graduate students, and applied it to the care of patients. Today, members of other departments share in the scientific aspects of this work. Indeed, the scientific activity of a member of an academic department of pathology differs from that of the scientists in other clinical departments primarily in that he is not directly responsible for the management of patients but instead assists in their care by the study and interpretation of laboratory work. However, since this clinical work of departments of pathology gives them a unique access to a vast amount of material which is essential for understanding human disease, it is important that departments

of pathology maintain their active interest in the scientific basis of disease and so continue to contribute to our understanding of disease processes.

The development of newer methods for the study of biological problems has made it possible to apply more sophisticated techniques to the study of human disease. In particular, the advances in the physical sciences, biochemistry, and cell biology have had a major impact on our ability to study the cause of disordered function. This has affected the research, teaching and service functions of pathology. Since the trends in modern biological science make it difficult, if not impossible, to separate the study of structure and function, the classical concept of a department of pathology as having an interest only in tissue pathology or morphology is not applicable in an academic centre, or indeed elsewhere. Of necessity there will be individuals in departments of pathology whose primary qualifications and interest is in tissue pathology, but in addition there must be individuals with interests in other areas of human disease such as epidemiology, biochemistry, immunology, genetics, cell biology and the molecular aspects of pathology.

Today it is not good enough to study or to teach only the morphological characteristics of what happens to injured cells and tissues, even at an ultrastructural level. One must relate the structural changes to the alterations in cell and tissue metabolism and function.

Equally, at the clinical end of the spectrum, departments of pathology must have individuals skilled in all aspects of modern laboratory medicine. For example, they must understand the implications and value of automated equipment and the implications of data collection and handling. This will require a clear understanding of the meaning of laboratory data in respect to the concept of normal and abnormal. Data will have to be interpreted within the context of the distribution curve of a value for that age and sex. It is particularly important that there be in clinical pathology men with sufficient knowledge of modern science to adapt the newer discoveries of fundamental and technological research and apply them to the care of patients. There is not much point in spending large sums of money on research if the knowledge gained cannot be translated into the skills needed to manage the health of the community. Clinical pathology has also its own area of research. For

example, it is unlikely that we have obtained more than fifteen percent of the information which can be secured from the study of post-mortem material. This failure gives us a major opportunity to improve the accuracy of tissue diagnosis and achieve a better understanding of some of the important diseases which afflict human beings.

It is against this background of opportunity, need and responsibility that one has to consider the educational, scientific and clinical needs of pathology.

The personnel needed by academic Departments of Pathology can be considered in three categories:

- 1) The personnel required to conduct successful undergraduate and graduate programmes in pathology, and to maintain the essential research programmes.
- 2) The personnel required to provide adequate post-graduate training programmes in the whole area of laboratory medicine, 'including the application of new knowledge to day-to-day practice, particularly by the development of new methods.
- 3) The personnel required to maintain the clinical pathology services.

The education and recruitment of individuals for each of these areas has major implications for medical education, the operation of hospitals, the delivery of health care in the community, as well as for the science of pathology.

It follows from what has been said that academic departments of pathology have three main functions, research, teaching, and clinical service. It is wrong to separate these three functions from each other, because there are aspects of each which are important for the others. For example, a basic course in cell biology suitable for a graduate programme leading to a Ph.D. in experimental pathology is also suitable for those being trained in service pathology, and the material available from the operation of the service laboratory is valuable for individuals studying the basic mechanisms of human disease.

The various aspects of the work of the academic departments of pathology will be considered at greater length in the sections which follow, and recommendations for the future development of the academic departments of pathology will be suggested.

V. THE CLINICAL RESPONSIBILITY OF ACADEMIC DEPARTMENTS OF PATHOLOGY

The care of the individual sick person is the first and over-riding responsibility of all medicine. To this, all else must be subjugated. It is, therefore, the responsibility of every pathologist in clinical practice, as it is the responsibility of every other physician in clinical practice, to place first the needs of the individual patient.

This responsibility is no handicap to an academic department of pathology. Rather it is its greatest strength. Without it, we could not maintain the quality of our teaching staff or teach well undergraduate and postgraduate students of medicine, and without it the continuing advance in our knowledge of disease would be slowed and curtailed.

These points deserve expansion. First, the teacher of pathology has many tasks, but two of his principal responsibilities are to teach medical students, and to train postgraduate and graduate students, both those intending to become pathologists and those entering other specialties. The great majority of these students intend to enter clinical practice, and their training must be directed to this end. Unless the teacher is fully familiar with

the day to day demands of clinical work, and can adapt his instruction to the rapidly changing demands of medicine today, he will be unable to maintain the quality and relevance of his course. This familiarity with clinical work, and the authority it lends, can only be maintained if the teachers preserve their active clinical practice of pathology.

Similarly, the students, whether undergraduate or postgraduate, must learn in a clinical context. Pure theory is not enough, and has not been enough since the Middle Ages. Both undergraduate and postgraduate students must be taught practically. To learn how to care for the sick, they must share in the care of the sick.

This is not to say that clinical experience alone is all that is needed to teach pathology. This would be far from the truth. Pathology rests on two foundations, clinical experience and investigation. Both must be fully displayed in good teaching. Some teachers will be primarily clinicians, some will combine research and clinical work, and some will be pure investigators. All are essential if the quality of instruction in pathology is to be maintained at a high level.

Active clinical responsibility is also of great importance in facilitating the extension of our knowledge of disease which is another of the major responsibilities of university departments of pathology. Much of our present knowledge of the causes, mechanisms, nature and course of disease, has been gained from clinical practice of pathology, and much more valuable knowledge will be gained in this way in the future. It is of particular importance to apply to clinical pathology the many new techniques of investigation now available, both to increase our knowledge of disease and to improve the quality of patient care.

These advances in knowledge, on which the quality of the care of the sick depend, are greatly accelerated when clinical observation is assisted and extended by experimental studies. Departments of pathology are particularly fortunate that their work lends itself to an easy correlation of clinical and experimental investigation. It follows that experimental work is of particular importance in departments of pathology. Without it their clinical services will be truncated and weakened, their teaching programmes will become artificial and enfeebled, and the development and application of new knowledge will be impaired.

Indeed, to draw any opposition between clinical and experimental work in pathology is foolish. Both are essential. Clinical and experimental pathology are inter-dependent. If either is weak, both suffer.

Thus clinical responsibility is one of the main resources of academic departments of pathology. The nature and extent of this responsibility need some consideration. Like so much else in medicine, they are changing rapidly and sometimes radically.

In Canada today, pathology is practised in many ways. A few pathologists are in private practice, serving as consultants to their colleagues in the private practice of other specialties. Many practise in smaller hospitals, where they are responsible for all aspects of laboratory work, anatomical pathology, haematological pathology, chemical pathology, and microbiology. Others practise in large hospitals where the department is subdivided into its subspecialties. Most university departments of pathology are of this type, with the clinical work in pathology divided into more or less autonomous units of surgical pathology, autopsy work, cytopathology, haematology, blood banking, bacteriology, virology, chemical pathology, and so on. As has

been mentioned earlier, the way in which these subdivisions are organized varies from university to university, but however this may be, all the subdivisions must maintain an exemplary clinical service, of the same type as is required in a non-teaching hospital, but usually more extensive and more complex. Many of the less common procedures which are not appropriate in smaller hospitals must be provided in the university centre.

Most of the staff of the university departments of pathology have restricted their practice to one of the subspecialties of pathology, morphology, chemistry, haematology, nuclear medicine, or one of the others. This is in many ways unfortunate, reducing the breadth of experience of each individual, but is inevitable as the quantity of medical knowledge continues to expand. In recent years, this tendency to subspecialization, or super-specialization, has become even more marked, and this trend seems likely to continue. Particularly in university centres, special units are being developed, for nephrology, cardiology, lung disease, and so on. Some of these have grown still more specialized, being confined to some special technique, such as renal transplantation. These special units have placed new

demands on the academic departments of pathology. In many cases, the special units require new and accurate measurements, which add greatly to the work of the chemical section of the laboratory. They also need the collaboration of specially skilled pathologists in the detailed study of their patients that is typical of these units. These new requirements are not only urgent, but are a very desirable development for the academic departments of pathology, adding greatly to their strength clinically, pedagogically and for research. They do, however, demand a heavy price. Such services are very expensive in staff time. For example, a simple biopsy studied by the usual methods usually takes from 5 to 60 minutes of staff time, but a biopsy studied by electron microscopy may take days. To further compound the problem, with the development of regionalization, these special services should be extended to the whole community, and be made available to other hospitals which do not have such special units.

When the staff and facilities available in our existing departments are measured against these requirements, our state is poor indeed. In almost every area, the physical facilities available are grossly inadequate, perhaps most markedly so in

chemical pathology and bacteriology. The staff is also grossly insufficient. In chemical pathology and microbiology the deficiency is so great that we cannot even make a sensible estimate of the need. Haematological pathology has long been given over to amateurs, basically trained only in some other aspect of pathology or in internal medicine. In no area is our strength adequate.

One weakness deserves special comment. Nowhere in Canada is there a good academic centre of forensic pathology. This lack reflects most adversely on the quality of forensic pathology practised in Canada, on the quality of advice available to the courts, and is a major deficiency in our postgraduate programmes. Forensic units should be established in the academic departments of pathology, to provide expert consultative services, assist in the training of postgraduate and graduate students, and add to the research strength of the departments. It is important that these units be not established in isolation. To maintain their quality they must join in the interchange of knowledge and criticism only found in a larger department; they must be able to draw on the advice and support of their colleagues in all the subspecialties of pathology; and they must assist in the urgent

task of improving the forensic training of postgraduate students, and so enhancing the standard of forensic pathology in the country.

The pre-eminent need to place first the interest of the sick person compounds our weaknesses. At all times, we must have available the staff needed to maintain our clinical services in that state of excellence which should be typical of university hospitals. As these men must give their first care to the patient during their tour of clinical duty, and so are not available for teaching or research, additional staff who have been temporarily relieved of clinical responsibility are needed to provide for these tasks.

The staff needed in a university department of pathology is much greater than that required in a non-teaching hospital, even if only the clinical responsibility of the department is considered. It must not only maintain excellent services in all the aspects of pathology, morphology, cytology, haematology, microbiology, and chemistry, usually in much more elaboration than is needed in a non-teaching hospital, but also must provide the special services required by the special units found in teaching hospitals.

As has been mentioned, these special services are expensive, particularly in staff time. Then, in addition to all this, staff who have been temporarily relieved of clinical responsibility are needed to provide for teaching and research, and a core of full-time research men must be provided to maintain the research programme essential to the maintenance of excellent clinical services, and a competent staff.

VI. ACADEMIC DEPARTMENTS OF PATHOLOGY AND REGIONALIZED HEALTH SERVICES

The development of regional medical services will have a major effect on academic departments of pathology. The Ontario Council of Health, the senior advisory body to the Minister of Health and the Government of Ontario, is concerned with the development of health services on a regional basis to provide total health care. Regional boundaries have not been defined but five regions, based on health science centres, are contemplated and it would be logical that the regional health organization should be based on university spheres of influence and interest.

Medical schools are exploring approaches to medical education in which the provision of health care to the community is delineated as an appropriate prime function for a university, in addition to its more traditional roles in teaching and research. In fact, medical schools have always had major responsibilities for patient care and community service. In the past these have sometimes been justified in terms of educational needs. The new approach is based on the fundamental idea that in a modern medical school teaching and research are complementary to and

serve to elevate the quality of health care, and that service responsibility stimulates and expands teaching and research. Indeed, the terms "teaching" "research" and "service" denote overlapping areas rather than define boundaries. It is evident that the provision of the well-trained physicians and the new advances in health care which have been derived from research are a high order of community service.

The regionalization of health services will mean that certain laboratory services will be centralized, as will other kinds of medical care. Each hospital in a region must maintain a satisfactory range of pathological services, but the less common or more demanding examinations will be referred to a central unit.

Such a central unit could be set up in isolation, without integration into a hospital or university. Experience has shown that such isolated units are unsatisfactory. Lacking proper clinical and scientific support, the quality of their work suffers. The lack of proper contact between the pathologist in the laboratory and the clinician caring for the patient is particularly disastrous. An isolated centre does nothing to assist in undergraduate, postgraduate or graduate teaching. The information

it gathers cannot be utilized to increase our knowledge, except perhaps in bioengineering. There is a grave risk that the requirement for providing reports will be allowed to dominate its development, seriously impairing the quality of the diagnostic service provided. Staffing with men of adequate calibre will be difficult.

Rather, such central units should be set up in large, central hospitals which can serve the whole region, and preferably should be in a university centre. It is not necessary or desirable that all functions be centred at the same hospital. Different hospitals should have different strengths.

As has been pointed out earlier in this report, the integration of teaching and research with service functions is essential to good undergraduate, graduate and postgraduate training. The development of appropriate regional services in academic departments of pathology would assist in this work, and assist in the recruitment and education of the staff needed.

The growing availability of computers for the storage and analysis of data will be of great value in the development of such regional pathological services. This development should be co-ordinated so that the various centres have compatible

systems, to permit the ready interchange of the data needed for patient care, research, and education.

VII. UNDERGRADUATE TEACHING IN ACADEMIC DEPARTMENTS OF PATHOLOGY

Traditionally, the department of pathology has been responsible for taking the undergraduate student of medicine from his studies of the basic sciences into clinical medicine, and has given him his first real knowledge of the nature of disease and of how it affects a sick person. The course in pathology given to medical undergraduates has usually been divided into two sections, general pathology which discusses the general nature of the disease processes, and special pathology which describes the individual diseases which affect the various organs and systems. The course usually begins about the time that instruction in the basic sciences is ending, and continues through the years of clinical teaching.

A similar course is given to dental students, modified to meet their rather different needs.

This is not the place to discuss how best pathology would be taught, or how the undergraduate curriculum would best be organized. The load of undergraduate teaching is, however, heavy, and places a considerable strain on most academic departments of pathology.

With the increasing complexity of pathology, this load must increase. The modern student of medicine must not only understand the anatomical lesions of disease and the microbiological agents which may cause them, but must understand the chemical derangements that accompany disease, the functional disorders that may result from it, the relevance of immunological or genetic mechanisms to disease, the rôle of drugs in modifying disease processes, and many other rapidly growing aspects of pathology. In this work the members of the department of pathology collaborate with members of many other departments, but it is the department of pathology which must bear much of the load. Its members should be specially skilled in these matters, and should teach them.

Few departments of pathology are able to do so optimally. In most cases, their staff is grossly inadequate to meet all the demands made on them. With so many other responsibilities, the staff cannot spare the time which should be given to the undergraduate curriculum. Only too often, teaching is hurried and given without enough preparation.

Another problem is even more pressing. With the increasing complexity of pathology, academic departments of pathology must

develop diversified staffs, both with men who have had special training in the various aspects of clinical pathology, and men who are investigating various aspects of disease. To be efficient, a department of pathology must have a wide base. It must teach all the aspects of general pathology, inflammation, immunopathology, molecular pathology, neoplasia, and must apply the findings of such disciplines as genetics and epidemiology to this work. Ideally, this teaching would be supported in each department of pathology by investigators in each of the main areas of study. If this cannot be achieved completely in each medical school, it should be possible in the departments of pathology of the Province considered collectively. Similarly, the tendency to utilize very narrowly specialized internists and surgeons to teach medical students requires that similarly specialized pathologists be provided to keep the instruction in balance. Such super-specialist pathologists should not only be authorities in the clinical aspects of their superspecialty, but should be active in research in their field.

There is thus a great need for teachers of pathology who have been trained in one of the scientific bases of human biology

and are able to apply methods from disciplines such as biochemistry, biophysics, or biomathematics to research in pathology. Such men must be soundly based scientifically, but should also have a general knowledge of the clinical aspects of pathology. There is an extreme shortage of such men. There are only a few programmes now established to train them, and all medical schools need more of them. Our only recourse is to develop programmes to train this kind of experimental pathologist, if we are to meet effectively future demands.

The rôle of the teacher has received little kudos in recent years. It is important that this error be reversed, if good men are to make the important task of teaching undergraduate and other students of medicine their first responsibility.

VIII. POSTGRADUATE TRAINING IN ACADEMIC DEPARTMENTS OF PATHOLOGY

In Ontario at the present time, pathologists share with psychiatrists the distinction of having the most severe shortage of any of the specialties. The Royal College estimated that 790 pathologists were needed in Canada, and that only 369 were in practice, leaving a deficiency of 421 (C.M.A.J., , 97: 1585, 1967). Even this figure could not have been achieved if it were not for the considerable influx of men from the United Kingdom and elsewhere. A survey of 1968 resident staffs leaves no doubt that the number currently in training will be insufficient to improve the situation.

An increased enrolment in residency training programmes in Canada is, therefore, essential. The initiative and leadership must come from the university departments of pathology. Indeed, the responsibility is placed squarely on their shoulders by the recent decision of the Royal College of Physicians and Surgeons of Canada to withdraw recognition of one year training programmes in smaller hospitals and to encourage university sponsored programmes involving their teaching hospitals. This decision may furnish the university programmes with more applications, but the job of upgrading both the programmes and the quality of

trainees will be no less difficult. Pathology as a specialty has not proven itself sufficiently popular, and nothing but a Herculean effort will encourage good applicants, particularly Canadian graduates, to enter Canadian programmes. While fewer Canadian graduates seek advanced training in pathology in Britain and Europe than formerly, the U.S.A. provides almost limitless scope for training in every branch of laboratory medicine, with large staffs, good facilities, excellently organized training, and adequate pay. Far more Canadians take pathology training in the U.S.A. than vice versa. This may not be an undesirable pattern in itself, but a considerable proportion of the men trained never return to Canada. Any reverse brain drain we enjoy in pathology is largely in the form of Asiatic students whose visas have run out in the U.S.A. They form a large and important group without whom our training and staffing problems would appear, not serious, but disastrous. The American centres, moreover, provide us with a screening mechanism by which we can select the best of these individuals. Hiring them direct from their homes would be more difficulty in every way.

Pathology departments will also have to continue cooperation with other departments in providing training in

pathology for men in other specialties.

As has been mentioned earlier, the development of subspecialties in pathology is proceeding rapidly, and seems likely to continue to develop for several years. Most departments of pathology have already developed several areas of subspecialization, and will probably recognize several further subsections within the next few years.

The Royal College has recognized this trend by setting up examinations in the subspecialties of Anatomical Pathology, Haematological Pathology, Medical Microbiology, Medical Biochemistry, and Neuropathology as well as maintaining the qualification in General Pathology, embracing all these fields.

Several types of postgraduate training programme must be set up to meet these needs. These programmes will require provision for the following:

- 1) Apprentice-type training in pathological anatomy, both surgical and autopsy, using routine hospital cases. This is the traditional form of residency training; the backbone of most programmes; done very successfully, although to the neglect of other aspects.

- 2) Similar apprentice-type training in the other subspecialties of pathology. In most centres, these programmes are less developed than that in anatomical pathology.
- 3) A seminar type of programme to assist the resident in his studies and to emphasize new developments in pathology. This type of education cannot confine itself to a consideration of new observations using old methods, but must embrace as well consideration of new methods. This is important not merely to ensure the use of valuable new approaches in the future, but to give the resident a critical sense of judgment. Many of the suggestions advanced will be totally impractical, and the pathologist must be able to evaluate the evidence for and against innovations. Courses of this kind must also be given to assist residents training in other specialties, and by men in other specialties to assist men training in pathology.
- 4) Opportunity for the resident to pursue selected studies of his own choosing in depth. It is unrealistic to expect all residents to develop research interests, but

are capable of being stimulated to a special interest in some aspects of pathology. In this way, at the least the trainee can develop a measure of excellence in one area that will be satisfying to him and useful to the group with which he eventually associates. Individuals with a serious interest in research are in a better position now as the new Royal College regulations recognize one or two years of research towards qualification in some sub-specialties. This means that an aspiring pathologist could take a Ph.D. as well as his Fellowship with the addition of only one year to his training. Such a combined programme will be only for a few individuals, but all steps possible must be taken to interest the occasional exceptional candidate, who can become the kind of experimental pathologist mentioned earlier and is first class material for a university staff.

Once again, the departments of pathology are ill-equipped to perform these tasks well. If they are to develop and maintain good postgraduate programmes, they need more space, more equipment, and more staff. If space and equipment are missing,

a good staff cannot be developed. If the staff is too small, all its time must be spent in service pathology, and the training programme becomes a farce. What resident staff there are will be used as work horses for service duties, and will learn little. There must be additional staff provided if a training programme is offered.

There is another important consideration. All the activities of a resident are part of the training programme. These activities include such things as examining surgicals and discussing cases at rounds, but they also include spending time in the library. Still more importantly, research must be recognized as part of specialty training, if we are to produce pathologists who are aware of new developments, and are able to apply them, particularly in the years after their training is finished.

Regardless of whether the body funding residency training is primarily interested in provision of patient care or in higher education, it is of utmost importance that hard lines are not drawn between research and clinical service in departments of pathology. Unless residents can be trained in both aspects of pathology, the quality of the pathologists we produce will

be impaired, and the quality of our clinical services imperiled.

It must also be realized that the resident is not an employee rendering a service but is being trained. Though active participation in service work is an essential and major part of residency training, the resident is not employed primarily to render a clinical service. The provision of the clinical service is a responsibility of the staff. If a residency programme is offered, the load on the staff increases. It must be large enough to supervise the resident's clinical work closely, assisting him and teaching him as he works. It must ensure that the resident is not assigned too much work, to the detriment of other aspects of his training. It must provide the seminar instruction that is now essential. It is clear that more staff is needed to meet the greater responsibility.

IX. GRADUATE TRAINING IN ACADEMIC DEPARTMENTS OF PATHOLOGY

As has been stressed repeatedly in this Brief, graduate training in pathology cannot be separated clearly from the other responsibilities of academic departments of pathology. It reacts with the teaching programmes at all levels, both supporting them and being supported by them. A good graduate programme will do much to strengthen the clinical services in pathology, and can in turn draw much from them.

In most of the academic departments of pathology in Ontario, graduate students can register for the degrees of Master of Science or Doctor of Philosophy. Those registered for the degree of Master of Science must spend one or two years in residence, while those registered for the doctorate of Philosophy require at least three. If certain restrictions are met, one of these years may be spent in another university.

The majority of the graduate students in pathology have a medical qualification. Many have completed their specialty training in pathology or some other specialty, or expect to do so. A few undertake graduate training immediately after internship, with the intention of pursuing a career in research. Occasionally, a student whose primary qualification is in dentistry

or veterinary medicine is accepted, and occasionally a student whose previous training has been in biological science.

The essence of the graduate programmes in pathology is research training in collaboration with the trainee's supervisor. With some exceptions, little stress is placed on course work. Most of the candidates have recently completed their M.D., and have fulfilled the requirements for course work in so doing.

Several different kinds of research are needed. A department of pathology should be active in basic research, preferably, as stated earlier, in several of the areas for which it is responsible. It must also engage in clinical investigation, and should be active in every area which is being actively pursued in its centre. In addition, it should have a programme of developmental research, applying the findings of basic and clinical investigation to clinical pathology, and the care of patients. All three kinds of research offer excellent opportunities for training graduate students.

The principal problem is again in staff and time. If a man is to supervise a graduate student he must be able to give to him the attention that he deserves. This takes a lot of staff

time. A man cannot supervise a graduate student properly if he has to spend too much of his time in clinical pathology or in teaching. Proper training of graduate students also requires active and varied research programmes. No department of pathology in Ontario is more than adequate in this respect. All need expansion and diversification of their research effort.

An active graduate programme is of great value to the department. The graduate students help greatly in the development of healthy research programmes, and have an excellent effect on other men who may be training in the department in some aspect of clinical pathology.

X. OTHER TEACHING RESPONSIBILITIES OF ACADEMIC DEPARTMENTS
OF PATHOLOGY

This Brief has been concerned mainly with the relationship between undergraduate, the graduate and postgraduate programmes offered in departments of pathology and the clinical services of departments, and the interaction of teaching and service with research. It would, however, be misleading if no mention were to be made of other duties which make demands on academic departments of pathology, and sometimes may place very heavy strains on a department.

The teaching of other undergraduate students, in physical and occupational therapy, pharmacy, and so on is another important task. Frequently, shortage of staff and time makes it necessary to relegate this work to very junior people, or to those not best fitted for the task.

The various kinds of technicians must be trained to assist in the work of pathological laboratories, in hospitals and elsewhere. This kind of training is regulated by the Canadian Society of Laboratory Technicians, but much of the work devolves on members of departments of pathology. The work is important, but staff and time are usually lacking. The lack of well trained

technicians is one of the greatest barriers to the efficient conduct of clinical laboratory medicine. Technician training urgently needs expansion and improvement. Consideration might be given to enabling suitable applicants who have obtained an advanced diploma from the Canadian Society of Laboratory Technicians to proceed to a university in which they might work towards an advanced degree such as an M.Sc. or even a Ph.D. Courses are also given to nurses and other para-medical people. Even undertakers and chaplains seek courses in pathology.

Improved and expanded programmes of continuing education for pathologists in practice, and for other physicians in practice, are needed urgently. Little is done now, and the need is great.

To all these tasks must be added the responsibility of the members of the academic departments of pathology to serve on the numerous public and professional bodies that seek their services. This responsibility is important, and not to be taken lightly.

XI. CO-OPERATION BETWEEN DEPARTMENTS OF PATHOLOGY IN ONTARIO

It is clear that each university centre must develop complete clinical services in the various aspects of pathology, and must develop the various super-specialties of pathology needed in its region. Each department must expand its research programme and improve its facilities for training graduate students. Each centre must also develop the programmes needed to train men in General Pathology, and in as many of the sub-specialties as is possible. It would be quite unreasonable to restrict these developments, or to envision the parcelling out of the subspecialties of pathology among the various Ontario medical schools. The pressures of teaching and service would not permit.

This expansion will generate requirements for space and equipment. However, it must be emphasized that for the most part the basic instrumentation available in most departments of pathology is applicable to most of the subspecialties. The fundamental techniques of light and electron microscopy, biochemistry, and so on are common to most spheres of diagnostic and investigative work, in pathology.

It is thus reasonable to expect that the Ontario medical schools will all have an increasing number of subspecialty pathologists on their staffs, and that the basic departmental facilities will be developed to provide adequate opportunity for diagnostic, teaching and research activity in several spheres in each university.

This is not to say that there will be no collaboration between departments in different universities. Such collaboration exists now, and should be developed further. On the clinical side, no single department of pathology can be all sufficient. Collaboration between departments should be developed, so that all can benefit from special skills available in one. Similarly, in postgraduate training, men may move for a period to another university to obtain a kind of training that is not available in their own institution. It would be foolish to duplicate certain highly specialized facilities requiring costly equipment and installations. Those wishing to work in with the nuclear devices being installed at McMaster, for example, should move to Hamilton for as long as may be appropriate. While graduate students must spend the majority of their time in their home

department, they might move with great advantage to another department to obtain some special skill, or to perform some particular experiment.

The development of such special facilities in one centre does not impair the development of research, teaching programmes or clinical services in other centres. In general, such special facilities are not closely related to any particular area of pathology, but serve to increase the technological resource which can be applied in many fields of pathology, and indeed in many other areas in medicine. Such units do not, therefore, place constraints on the proper development of the individual departments of pathology in the universities, but rather serve to increase the depth of technology available to all.

XII. RECOMMENDATIONS

1. That the departments of pathology in Ontario be developed so that all have the facilities, equipment and staff needed to allow them to perform well their three principal tasks,
 - a) the provision of excellent clinical services
 - b) the development of good teaching programmes
 - c) the development of strong research programmes
2. That the staff and facilities be made available to permit the proper development of all aspects of clinical pathology, with particular emphasis on those aspects of the service which are weakest. Among these are the services in chemical pathology, microbiology and haematology.
3. That the staff and facilities be made available to permit development of the emerging subspecialties of pathology as may be appropriate in each centre.
4. That forensic pathology units be established in university departments of pathology.
5. That centralized regional laboratory services be established in university departments of pathology where possible, and fully integrated with the work of the departments.

6. That a compatible system of computerization of records be introduced across the Province to permit easy exchange of information and the application of pathological data to the problems of health care.
7. That staff and facilities be provided for the development work needed to apply advances in knowledge to clinical pathology and the care of patients.
8. That the staff needed to set up good postgraduate programmes for those training as pathologists and for those training in other specialties be provided.
9. That the funds to support men training as pathologists be provided so as to support a man throughout his training, without distinction as to whether he is termed a resident and is engaged in clinical work or is termed a fellow and is engaged in research work.
10. That staff and facilities be provided to permit all academic departments of pathology to expand and diversify their research work.
11. That funds be made available to support graduate students training in experimental pathology with a view to becoming teachers in the Province.

12. That staff and facilities be provided to permit development of a complete programme of continuing education for practising pathologists, and other physicians.
13. That staff and facilities be made available to permit expansion and improvement of the programmes for training technicians.

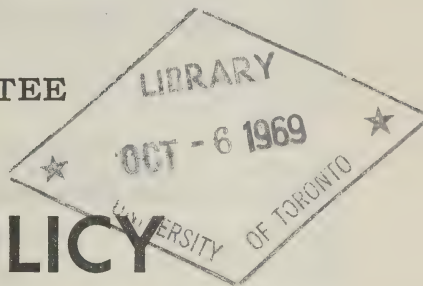


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THE SENATE OF CANADA

PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON

SCIENCE POLICY



The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 54

THURSDAY, JUNE 5th, 1969

WITNESSES:

The Royal Society of Canada: Dr. C. E. Dolman, President, Dr. Léon Lortie, Past President, Dr. S. D. Clark, Dr. Roy Daniells.

APPENDIX

112—Brief presented by The Royal Society of Canada

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, June 5, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.10 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Cameron, Grosart, Haig, Kinnear, Phillips (*Prince*), Robichaud, and Yuzyk—8.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

THE ROYAL SOCIETY OF CANADA

Dr. C. E. Dolman, President

Dr. Léon Lortie, Past President

Dr. S. D. Clark,

Dr. Roy Daniells

(A curriculum vitae of each witness follows these Minutes)

The following is printed as an Appendix:

No. 112—Brief presented by The Royal Society of Canada.

At 12.35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Clark, Samuel Delbert. Born Lloydminster, Alberta, 1910. Educated University of Saskatchewan, B.A., honours history, 1930, M.A., 1931; London School of Economics, 1932-33; McGill University, M.A., Sociology, 1935; Ph.D., University of Toronto, Political Science, 1938. Guggenheim Fellow, 1944-45; Tyrrell Medal, Royal Society of Canada, 1960. President, Canadian Political Science Association, 1958-59; Honorary President, Canadian Association of Sociology and Anthropology, 1967. Publications: *The Canadian Manufacturers' Association: A Study in Collective Bargaining and Political Pressure* (Toronto, 1939); *The Social Development of Canada* (Toronto, 1942); *Church and Sect in Canada* (Toronto, 1948); *Movements of Political Protest in Canada, 1640-1840* (Toronto, 1959); *Urbanism and the Changing Canadian Society*, editor (Toronto, 1962); *The Developing Canadian Community* (Toronto, New Edition, 1968); *The Employability of the Older Worker* (Ottawa, 1969); *The Suburban Society*, (University of Toronto Press)—published in January 1966. Academic History: Lecturer in Sociology, University of Manitoba, 1937-38; Lecturer to Professor, University of Toronto, 1938; Chairman, Department of Sociology, University of Toronto, 1963-69; Visiting Professor, University of California, Berkeley, 1960-61; Visiting Professor, Dartmouth College, Spring Term, 1967.

Daniells, Roy. Born London, England 1902. To Canada 1910. Educated Victoria, B.C. schools; U.B.C.; University of Toronto B.A. (U.B.C.) 1930; M.A. (Toronto) 1931; Ph.D. (Toronto) 1936; LL.D. (Queen's and Toronto) 1964. Served as Chairman of Humanities Research Council and of Governor-General's Awards Committee. Publications: *Deeper into the Forest* (1948); *The Chequered Shade* (1963); *Milton, Mannerism and Baroque* (1963); *Alexander Mackenzie and the North West* (1969); contributor and associate editor to *Literary History of Canada* (1965). Academic history: Department of English, Victoria College, University of Toronto, 1934-7; Head, Dept. of English, University of Manitoba, 1937-46; Head, Department of English, U.B.C., 1948-65; University Professor of English, U.B.C., 1965, now working on a book dealing with Mannerism in Italian painting and English poetry.

Dolman, Claude E. Born in Porthleven, Cornwall, England, 1906. Education: From Wallingford Grammar School obtained an Open Scholarship to Christ's Hospital (1916), where he was Senior Grecian (1925). Won Open Scholarship to St. Mary's Hospital Medical School, University of London, and became Gold Medallist in Clinical Medicine. Became Research Scholar at St. Mary's Hospital Institute for Pathology and Research (later known as the Wright-Fleming Institute), 1929-30; and was Research Associate under Sir. Almroth Wright and Prof. Alexander Fleming, 1930-31. Held various part-time clinical appointments (1929-31), including House Surgeon to Senior Surgeon, St. Mary's Hospital; also Clinical Associate at The Royal Chest Hospital, at Queen's Square Hospital for Epilepsy and Nervous Disorders, and at Great Ormond Street Children's Hospital, London. Degrees & Diplomas: M.R.C.S. (England), L.R.C.P. (London) 1929; M.B., B.S. (London) 1930; D.P.H. (London) 1931; M.R.C.P. (London) 1931; Ph.D. (London) 1935; F.R.C.P. (London);

F.R.C.P. (C) 1951. Previous appointments: Emigrated to Canada in 1931, to become Research Assistant and Clinical Associate, Connaught Medical Research Laboratories, University of Toronto. 1932-35, Research and Clinical Associate, Connaught Laboratories, and Demonstrator, Department of Hygiene and Preventive Medicine, University of Toronto. Since 1935, has retained a Research Membership in the Connaught Medical Research Laboratories. Moved to Vancouver in 1935, to become Acting Head and (1936-51) Professor and Head, Department of Bacteriology and Preventive Medicine; and (1951-65) Professor and Head, Department of Bacteriology and Immunology, University of British Columbia. Was also Acting Head (1935-43), and Professor and Head (1943-51), Department of Nursing and Health, U.B.C.; and Director, Division of Laboratories, Provincial Department of Health & Welfare, Vancouver (1935-56). Served for several years, commencing in 1939, as Member of the Executive Council and Editorial Board, and in 1941 was Chairman of the Laboratory Section, Canadian Public Health Association. Member, International Standing Committee on Public Health and Medical Sciences, Pacific Science Association (1955-59); Associate Editor, *Journal of Immunology* (1946-57); Member, Panel on Infection and Immunity, Defence Research Board of Canada (1952-67). National Research Council delegate to 9th Pacific Science Congress, Bangkok (1957). Official delegate to FAO/IAEA Panel on Microbiological Specifications for Irradiated Foods, Vienna (1965). Medical Research Council delegate to IX International Congress of Microbiology, Moscow (1966). Royal Society of Canada delegate to National Conference on "Pollution and our Environment", Montreal (1966). President, Canadian Association of Medical Bacteriologists (1964-66). President, Section III (Science Section), The Royal Society of Canada (1965-66). 2nd Vice-President (1967-68), and 1st Vice-President (1968-69), The Royal Society of Canada. Memberships in professional and learned Societies: Fellow: Royal Society of Canada (1947); American Public Health Association (1943); New York Academy of Sciences (1956). Member: Canadian Public Health Association, Canadian Association of Medical Bacteriologists; Canadian Society of Microbiology; American Association of Immunologists; American Society for Microbiology; Faculty of the History of Medicine of the Society of Apothecaries of London. Publications: About 100 papers in scientific and medical journals on bacterial food infections and intoxications, miscellaneous bacteriological researches; medical education, and the history of microbiology. Also, "The Epidemiology of Meat-Borne Diseases", in Meat Hygiene, World Health Organization, Geneva, 1957; "Botulism as a world Health Problem", in Botulism, U.S. Public Health Service, Cincinnati, 1964; "Water Resources of Canada", (Editor). University of Toronto Press, 1967. Present Appointments: Research Professor of Microbiology, University of British Columbia; and Research Member, Connaught Medical Research Laboratories, University of Toronto. Honorary Consulting Bacteriologist, Vancouver General Hospital; Member, International Committee on Microbiological Standards for Foods; Member, Editorial Board, *Excerpta Medica* (Microbiology); Consultant Editor, *Cytobios*; Consultant Editor, *Microbios*. President, The Royal Society of Canada.

Lortie, Joseph-Achille Léon: Born: 31 August 1902; B.A. cum laude U. de Montréal, 1923; Licencié ès sciences chimiques, U. de Montréal, 1927; Docteur ès sciences physiques, Paris 1930; Docteur ès sciences (honoris causa) Ottawa 1948; Caën 1957; LL.D.—McGill 1965; Has written over 400 articles on science and the history of science, and on education. Academic history: Lecturer in

Faculty of Science, U. de Montréal 1926-1928; Associate Prof. of chemistry, Faculty of Science, U. of Montreal 1935-1944; Prof. of chemistry, U. of Montreal 1944-67 then Director, Extension Division, U. of Montreal and Secrétaire-général of the University 1962-68. Having recently retired, M. Lortie is still Historian of the University. Fellow of The Royal Society of Canada The Chemical Institute of Canada (London), and member of many other associations; President, Greater Montreal Council of Arts; Past President, Canadian Institute of Chemistry, Association canadienne-française pour l'avancement des sciences, President Royal Society of Canada 1968-69.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, June 5, 1969.

The Special Senate Committee on Science Policy met this day at 10.10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the chair.

The Chairman: Honourable senators, we have the honour of having with us this morning the distinguished representatives from the Royal Society of Canada. First, on my right, is the new President, who was elected yesterday, Dr. C. E. Dolman, of the Department of Microbiology, University of British Columbia. On my left is the former President of the Society, Dr. Léon Lortie of l'Université de Montréal, and to my far right is Professor S. D. Clark, a sociologist teaching at the University of Toronto, and finally Dr. Roy Daniels, a humanist from the University of British Columbia. Without further introduction, because you will have the biographies of these gentlemen in our record, I will ask the new president of the society to give us a brief statement.

Dr. C. E. Dolman, (President, Royal Society of Canada): Senator Lamontagne, honourable senators, first may I express our appreciation of the opportunity to appear before you as a delegation from the Royal Society of Canada to discuss with you the brief which we presented several weeks ago. I take it that this therefore not necessary for me to quote excerpts from it at the outset. There are just a couple of points which I think one might informally stress, and a word of explanation is perhaps called for about its general structure.

First, as you will have read in the introduction to the brief, a peculiarity of our society is that we represent all aspects of learning and scholarship in the country. Fellows are elected by their peers for high accomplishment in their respective fields of learning. Sections and subject divisions deal with their own specialized interests, but we always make a point of meeting together and discussing some topic of lively controversial interest

and importance. This is, as far as I know, quite unique among the learned societies of this country.

We feel, Mr. Chairman, it gives us a special competence to deal from various points of view with matters that are intricate or controversial. I am sure, however, you will agree and know in advance that we cannot come up with ready answers today, should you put pointed questions involving details or important matters of policy. However, we do feel we have within our membership, individuals and groups of people who could and would give careful attention to such questions and bring to bear expert knowledge on them.

Another point I think worth stressing is that there is need among the learned societies for some measure of leadership and for some body to give co-ordination and coherence to their separate efforts. We feel, without I hope being presumptuous, and with definite encouragement from these other learned societies, that a better financial situation than we can at present command, would permit us to offer leadership and spokesmanship to these other learned societies. I believe this would be a useful thing to the country and a constructive measure from the standpoint of the deliberations of this committee.

The point of explanation I want to make relates to the somewhat disproportionate amount of space—in the view of some of our membership, more than two-thirds of whom are scientists in the popular sense of this term—given to the humanities and social sciences. We did this deliberately, not because the scientists felt their section less important, but because in the past they had already submitted briefs to members of the government, in particular some years ago to the Minister of Industry, which detailed their view on national expenditures on science.

The Chairman: We know, sir, you were the first to use the expression "Towards a national science policy". You were the first but not the last.

Dr. Dolman: That is correct, senator. Our society used that title for its 1965 brief. Thank you for noticing and mentioning it.

For this reason we scientists confined ourselves to abstract principles. We also felt that our colleagues in the humanities and social sciences have had far less attention given to them in documents of this sort and perhaps in government consideration than they deserve. I think, Mr. Chairman, that is all I need to say by way of preliminary statement. If you would like us to answer any questions the honourable senators care to put, we will attempt to do so.

The Chairman: Who wants to initiate the discussion? Until someone is ready to ask a question I have a number here. This is perhaps an error on page 4, line 5 of your brief when you say: "... just as no natural scientist had been appointed to the Canada Council". I do not know if you would recognize Dr. C. J. MacKenzie as a natural scientist but he is still, and has been for some years, a member of the Canada Council.

Dr. Dolman: Yes that was an oversight.

The Chairman: And I think that Dr. Spinks from the University of Saskatchewan is not a humanist or a social scientist but is, I think, what you would call a natural scientist.

Mr. Dolman: These are oversights, Mr. Chairman.

The Chairman: Yes. That is why I wanted to clarify it for the record now. I appointed Dr. C. J. MacKenzie myself some years ago.

Dr. Léon Lortie, L'Université de Montréal: Senator Lamontagne, I think they were not appointed from the start. It was the same with the Humanities and Social Sciences Research Councils, that there was no scientist at the start, Dr. Spinks and Dr. MacKenzie being appointed later. I think it is a question of history.

The Chairman: Yes. The impression I got from reading this was that this was still the situation and I thought you might want to change it.

Dr. Dolman: Yes, we will, by inserting the word "originally" after "appointed".

The Chairman: On page 7 you say at the bottom of the page:

We do not propose to add further fiscal data to the mounting pile of surveys of needs and resources, and of cost-analyses

respecting scientific research and development in all its facets.

This is perhaps a mounting pile, but I must tell you that it is also some kind of confusing pile, which is far from being comprehensive and complete up to now. One of our members, in particular our vice-chairman, Senator Cameron, has been campaigning more or less all along indicating that there has not yet been any kind of systematic attempt to compile an inventory of programs, projects and manpower in all the fields of scientific activity in Canada. Apparently it is very difficult to organize this. Perhaps you would like to comment a little bit about this problem because I do not think it is as near a solution as we might imply from that sentence on page 7.

Dr. Dolman: One assumes, Mr. Chairman, that one must have data before one can analyze it and determine priorities. I think the difficulty is we have not had the data and that various bodies have been appointed to accumulate it and at the same time to help with the elaboration of a policy, and they likewise were unable to advise on a policy until they had the data. I should think we are now at the stage when somebody will have to be delegated to sort out this matter of priorities in consultation with government authorities.

The Chairman: To sort out the data first.

Dr. Dolman: Yes, to sort out the data, that is quite true. Science by its very nature is bound to have its devotees, and it is quite unrealistic to expect that they are going to be modest in their demands when they feel that their own specialty is all-important. The humanists and social scientists feel likewise. I do not think that when asked to submit their needs, one can expect them to give first consideration to the claims of others, and therefore I am quite sure you are at the moment embarrassed by piles of demands which seem impossible to meet. It is just possible that a body such as ours might be of some assistance in this respect.

Senator Cameron: Mr. Chairman, there was a glimmer of hope yesterday with the biochemists. They have appointed. Dr. Fisher and he seemed to have a grasp of what is going on and is getting more information. The thing that discourages some of us is that many people say it is impossible, that there is so much information that it would be impossible to get an inventory and that it would be useless if we did get it. I for one am not prepared to

accept that. We do not want a lot of minutiae but we do want to get an indication at least of what is being done in the major areas because we cannot formulate a national policy for science unless we have that. That is basic.

The Chairman: What also worries us, I think, at the moment is that while there has been an attempt to make surveys in various fields, like physics for instance, and others, agriculture and others, and these studies have been made most of the time under the auspices of the Science Council or by the Science Secretariat, there is no overall approach. The study in physics may be obsolete very soon, and there are great gaps in other fields. We have almost nothing, as I am sure you know, in the whole field of the social sciences. We do not even know what is going on in any kind of detail, particularly in the field of the social sciences, within the federal government. So it seems to me there will be this great need for a kind of overall effort to try to collect most of this data and to organize some kind of continuous operation. To devote, let us say, \$100,000 for the solution of the problem in the field of physics in Canada and stop there, and then two years later find this is obsolete, I think would lead anyone to say that this money has been more or less wasted.

Do you think there should be some kind of service or organization working possibly in close cooperation with the DBS which should be responsible for this?

Dr. Dolman: It is a little difficult to see how one can reconcile the data-gathering function of the science secretariat and the science council, which is still proceeding, with the prospect of having some other agency sort out these data; because presumably in the process of collecting data they will analyze it and sort it and communicate it to each other. It is useless collecting data merely for their own sake. They have to be correlated and given some sort of priorities in significance.

I should think, Mr. Chairman, it would be useful to have some agency with no particular affiliations, that can study the data which have been collected and give an entirely objective opinion. I think this could be a very useful contribution.

The Chairman: If there is anybody who wants to comment here at any time, you are completely free to join in the discussion.

Senator Robichaud: Dr. Dolman, in your recommendations, and it is recommendation

No. 4 on the first page of your brief, you state:

The growth of a large, bureaucratic science policy apparatus within the government is undesirable. The Science Council of Canada is the soundest source of expert advice to the government on scientific issues and should be closely concerned with decision-making processes in this field. Through its chairman, the council's views on matters of national science policy should be sought by and made known to the responsible ministers.

You are not advocating a single minister responsible for the implementation of science policy, are you?

Dr. Dolman: I do not think there was any implication that there should not be such a minister in that statement, sir. It was just assumed that there is at present more than one minister vitally interested in science developments.

Senator Robichaud: It was not meant to say that you are advocating that sort of thing?

Dr. Dolman: Not at all.

The Chairman: In your brief, sir, I think you go a little further. Of course you say you are definitely against a minister or a department of science. You put, it seems to me, such stress on the importance of the science council, including its chairman, that the implication I draw from this is that you are against any kind of minister who would have any kind of particular responsibility with respect to science or science policy.

At page 14 of your brief, for instance, you say:

We do not favour the formation of such a department, but believe a more independent body such as the present science council, would serve the purpose better, provided an effective procedure can be devised for translating its recommendations into national policy.

Senator Grosart: Did you say page 14?

The Chairman: Yes, at the top of the page. In connection with page 14, in the United Kingdom, the situation—and I do not know when it was changed—is not exactly as you describe it there in the sense, as you know, I am sure, that they have a department of education and science, science dealing only with the universities, and they have another department dealing with technology.

Dr. Dolman: Yes.

The Chairman: So that the situation is perhaps a little more complicated than is described there insofar as the United Kingdom is concerned. But to come back to the more important point, I think you seem to infer there at least—well, you certainly say you are against a department of science and you seem to infer also that the Science Council, formed as you suggest, would do the job.

Dr. Dolman: Yes. I think the argument that motivated us there is that the science council as constituted, of selected members from across the country who are leaders in their different fields, would be in a position to give independent as well as authoritative advice, and that they should be encouraged to do so. If they measured up to what the situation obviously demanded, they should be intimately aware of what was going on in the country and should be in a position to advise the responsible minister or ministers.

This was not intended to infer that a minister of science was undesirable at all. What we were concerned about was that there should not be built up a bureaucratic apparatus administering science and deciding science policy without an independent body of reference that they would automatically seek guidance from.

I think that is the intention of the section there, not at all to indicate that we are opposed to a minister of science; but what goes with a minister is a very elaborate bureaucratic apparatus as a rule, and this we were anxious to see avoided until at least the Science Council has been given every chance to develop itself to its utmost potential. I hope we did not give the wrong impression by the wording that is here. If so, I trust this explanation will clarify the point at issue.

Senator Grosart: Of course, Mr. Chairman, it all depends on what you mean by bureaucratic apparatus. We find generally that the science community does not regard the addition of professional scientists to give advice as bureaucratic.

Dr. Dolman: No sir, I quite agree. Perhaps I should say scientists are human when they are asked to give a snap decision on some matter. There is a risk, it seems to us, that if a minister has attached closely to himself a group of appointees who are full time, with the expectation that they should give a snap judgment on something that is put to them, there is a risk that this opinion will not be as

sagacious and farsighted as would be the case, for instance, with the Science Council.

Senator Grosart: Would it make any difference, for instance, if the Science Council were asked to give a snap judgment?

Dr. Dolman: It should not give it in any case.

Senator Grosart: No, nobody should give it. I suggest that argument is not relevant to the problem here.

Dr. Dolman: I see your point. I just think there is a greater temptation to the individual who is attached more closely and who is full-time, to feel obligated to show his knowledge in these matters.

Senator Grosart: I am afraid my experience would indicate the very opposite, that one thing you do not get from bureaucrats is snap judgments.

The point that occurs to me here of course is the suggested role for the Science Council. It seems to beg the whole question because the real question is, who makes the political decision as between the respective claims of all of those who have a claim on the \$12 billion a year which we have to spend? Surely a science council is not going to be in a position to make that kind of analysis and assessment. That is why it has to be in the long run a political decision which creates the anomaly that the higher you go, the more difficult the decision and the less expertise you get into it. That is why under our system, rightly or wrongly, we decide that all the vital decisions, all the expert decisions, are going to be made by laymen. I think it was Lloyd George who once said that any time any brilliant man was elected to the House of Commons it was a denial of the basis of the democratic system because it was supposed to produce representative people. I do not say this is what has happened.

Would you, out of the thoughtful consideration that you have given to this problem, and it is reflected all through your brief, suggest the kind of mechanism that would fill this gap? You did make the point that the decisions should not be made without reference to some independent body of scientists, a scientifically oriented body.

I think in our sessions here some of us have come to believe this is a major decision that has to be made. Who makes the political decision? Under our system it is normally a minister who carries it through to his col-

leagues in the Cabinet. Under our departmental system it is true that the advice coming up is normally what you would call bureaucratic, although it has many other elements in it.

Assuming the science council can do this correlating job of gathering data, assessing it and passing on advice, who would it pass that advice to in the present political structure? In other words, should it report directly to the Prime Minister, or should it report to a cabinet committee or to a minister with specific responsibility to get to know something about science and technology? Which would be your choice? Or some other alternative? Or none?

Dr. Dolman: I think one could say we would have no objection to their reporting their considered advice to a minister delegated for that specific purpose.

Senator Grosart: Fine. Thank you.

Dr. Dolman: I hope that is definite enough, sir.

The Chairman: Dr. Lortie.

Dr. Lortie: Speaking as a representative of a lower level of government, I know what it means, having sat on the scientific council in Montreal, that the bureaucrats or even the experts who would be in the science council would report to the minister or the Prime Minister or to a body of ministers, and that is why we avoided saying anything about the science policy itself because it gets to be a political decision. We are all agreed on that. So we did not say much about the science policy itself but rather how it should be transmitted and that is why we stressed the science council, which is the proper body at the present time.

The Chairman: As an advisory body. But again on this problem you say at page 12:

We recognize the need for highly competent, confidential and readily accessible advice, and we believe the chairman of the science council, with the assistance (when required) of special sub-committees appointed by the council, is its best source.

I understand that until now at least the science council has not made any kind of private or confidential recommendations to the government. They have used always the public channels to make their views and their recommendations known. I wondered in that kind of situation what you think about this potential new role, as opposed to the role

which is assigned to the director of the science secretariat, who is giving only private advice or confidential advice to the Privy Council and perhaps ultimately to the chairman of the cabinet committee on industrial and scientific research, or to the Prime Minister. These are two quite different channels and you do not speak at all here about the science secretariat.

Dr. Dolman: Without having made a detailed study of the changing patterns of the science secretariat vis-a-vis the science council, I would say it stands to reason that a broader, more objective, and I think more considered judgment is likely to be given by a body of people such as comprise the science council than is true of one individual, even supported by one or two associates, who may be asked for an opinion which it is human enough to expect he would wish to give with a minimum of delay. He is there for that purpose, of being an adviser, and therefore he naturally wants to give advice. The science council is comprised of a great number of experts who would naturally not wish to give it until they consulted together. We think there is greater strength in that arrangement.

Senator Grosart: Do you see this science council operating very much in the same way that the Economic Council of Canada does? By that I mean having a degree of independence from government, rather than the closer association which you seem to suggest between the science council and the government?

If I may make that clear, I see a possible structure where the science secretariat is in effect the staff of a minister and the science council is completely independent, making periodic comments based on studies of the viability of the policies carried out by the department on the advice of the science secretariat. Or do you see a closer relationship between the science council with a permanent chairman and actual policy-making power?

Dr. Dolman: I think the point we wished to stress there was that the science council should at all costs remain independent of government, should be in a position to give an entirely objective viewpoint after due consultation among their membership, but that the government should not arrive at a decision, as now and again it seems to have done in matters of high concern to scientists, without having referred it to the science council.

Senator Grosart: The difficulty there of course arises that if the science council is privy and party to the decisions made it then becomes their defender, which is one of the main criticisms of our present system where the public service automatically becomes a defender of the policies in which it participates.

The Chairman: Perhaps you do not know the internal procedure of the Economic Council. While the economic council is entitled to give private and confidential advice to the government, according to their Act at the moment, they have not up to now at least, and insofar as I know, have refused to do that, and all the advice they have given to the government and various departments on policies has been public. The members of the economic council have always been very reluctant to allow their chairman to be a member of various government committees of officials and to go there and speak, even giving his own personal views, because they were afraid that he might not represent the views of his council.

Dr. Dolman: I see.

The Chairman: While I recognize this view probably is well-founded and justified, it carries with it a kind of rigidity so that if you go and seek the views of the economic council, then it may take a year or so before you get an answer. In this day and age of perpetual motion and change, it is not too satisfactory.

Senator Grosart: Not only that, Mr. Chairman, but both the economic council and the science council have developed what I can only call a device to get around this problem, and that is when matters are referred to them, to both of them, by the government, they tend now to say, "We will publish a paper but we do not take any responsibility for what is in it".

The Chairman: Well, that has been used.

Senator Grosart: This is the way it has gone.

The Chairman: Not all the time.

Senator Grosart: No, but this is the device they use to leave the door open for themselves to come back and criticize government policy. I think this is very desirable.

Dr. S. D. Clark (University of Toronto): Mr. Chairman, if I may intervene, I am not a scientist but it seems to me that the economic

council was set up to be representative of various interests.

The Chairman: They are economic interests. Now we have various scientific interests.

Dr. Clark: Yes, but it includes employers and labourers and, in other words, is not a council of economists, and the thought here is that the kind of council it is going to be is a council of scientists.

Senator Grosart: Hopefully some economic scientists.

The Chairman: I still maintain that economics is a science.

Dr. Clark: It is my feeling that this council would be much more ready to advise the government, the appropriate governmental minister, on matters of policies than has the economic council.

The Chairman: The economic council could certainly give very good advice to the government but it seems to me that these are two alternatives which cannot be easily reconciled. If you give private advice before a decision is taken then you would be in a difficult position insofar as coming back later and criticizing it in public. So either you give advice privately before a decision is taken or you keep your freedom and you criticize the decision when it is made. It is very difficult to reconcile the two.

Senator Grosart: Again it seems, Mr. Chairman, the science council has found a way out of this problem by saying, as they have said to us here, "We give only long-term advice, we will not give medium-term or short-term advice." This is the position that the science council has taken. This would wipe them out pretty well completely from giving any kind of advice that the politician needs when he makes the decisions which he has to do once a year.

What we are looking here for is your wise counsel and advice on a matter on which we probably have to make a fairly definitive statement in due course.

Dr. Dolman: I think you have put your dilemma very clearly, senator. I am a little surprised that there is no mechanism at present whereby you can get advice for a decision that has to be made in a matter of a week or two or a month on some scientific matter. If it has indeed been your experience, it is something that has to be rectified, short of

having to ask for a snap judgment of the sort I referred to before. In other words, there should be a body that would give an emergency but nevertheless very carefully considered review of a situation that has to be settled soon.

The Chairman: Well, this has been, so far as we know, one of the responsibilities of the science secretariat and the director of that secretariat, you see, up until now. The way you are trying to envisage the new functions of the science council, it would seem there would be very little left for the science secretariat to do.

Senator Grosart: Our medical friends told us last night in one of their briefs that they have not been able to find out what the function of the science secretariat was.

Senator Cameron: Mr. Chairman, there is another matter too. Taking your brief, Dr. Dolman, on pages 12 to 14, your view of a national policy on research in the natural sciences, and your recommendations with respect to the role of the science council, in this morning's *Globe and Mail* in a headline it says: "Royal Society Members Assail Science Council Plan". I am not too impressed with headlines because they can be very misleading but, reading through the body of the news story by David Spurgeon, am I right in assuming that there is a good deal of disagreement within the Royal Society with the report No. 4 of the Science Council? Reading this, and they quote some people I know, like Dr. Dunning of my own university, and a topflight scientist, and others like Dr. Douglas of the National Research Council, this is a little disturbing, to reconcile this report with your recommendation.

Dr. Dolman: This is a reference to the MacDonald report?

Senator Cameron: No, this is dealing with the Report No. 4 of the Science Council. It is in this morning's paper.

Dr. Dolman: I have not read this morning's paper.

The Chairman: Is this a discussion that took place during the meeting of the Royal Society?

Senator Cameron: The tenor of that seems to contradict the recommendation, if this is an accurate representation.

Dr. Dolman: Yes, I was present at the greater part of that symposium and I realize

now what the references are to, senator. I think it is well-recognized that there are two types of approach which scientists make to their problems. The so-called mission-oriented has become stressed greatly by the science council and it naturally tends, at any rate, to be more sympathized with by those employed in government agencies as scientists, where, it goes without saying, they are largely mission-oriented. But a substantial portion of our fellowship is affiliated with universities, where there is a long-standing tradition and a philosophy that the fundamental approach to science, the so-called curiosity-motivated research, is absolutely vital to the practical consequences that follow from these researches.

It is healthy and I think productive and useful that we should have symposia in our annual meetings that discuss these things in detail and in principle, as was done in the symposium that is the subject of this newspaper report. I would not say that it was quite fair to have a headline saying we assailed the science council plan. It was an academic debate in which the pros and cons of applied research were discussed. I think it is fair to say it was a good-tempered discussion in every respect. We found some government scientists taking very firm stands on the necessity for basic research to proceed. On the other hand, university members were tolerant enough to say that you could do better research if you had some motives besides curiosity. I myself could qualify for this category, since most of my research has had to do with matters of individual and public health. There is an 'applied' motive always behind such research, even though one might not accomplish much unless one used fundamental methods and approaches. So I think this newspaper story should not lead you to think that we are disgruntled or hold in disfavour the science council's policies.

We are disturbed at the general tendency to accentuate the necessity to look towards specific objectives and to apply it to the country at large. To downgrade fundamental research, in other words, is a bad long-term policy. It will impoverish the country of the people who are scientists by philosophy and persuasion and dedicate their whole lives to it.

A very well known example of that sort of thing, of course, is the discovery of penicillin, and I speak with some feeling here since I worked with Alexander Fleming within a

year of his discovery and I know exactly the whole story behind it, and I know him well personally. It would be quite absurd to assume his discovery could have been made if he had been given a sum of money to discover such a product. It was pure and simple curiosity, allied to a determination to follow up things that an ordinary person would have ignored as being of no significance.

I think this is the sort of argument wherein university members are persuaded by their own personal experience and by their knowledge of the history of science. I think it would be disastrous if we made it a matter of national policy to urge that no public funds, or a diminishing percentage of them, should be made available for these basic aspects of science. This is really what led to the heat and enthusiasm behind this argument. It was done in full understanding of each other's viewpoints.

I don't think it means at all that we were losing confidence in the science council, or that we should wish in any way to alter our view that this is an essential body. We should like to feel confident that the feelings of the Royal Society on this question were well known to the science council and to the government, that it would not be in the country's interest to advocate as a national policy that only applied science or science that yields obvious and near-term fruits should be supported by public funds. Have I made my point clear?

Senator Cameron: Yes. Mr. Chairman, let me make it perfectly clear that I think all members of this senate committee have the highest regard for the members of the Royal Society. It is pure accident in relation to this particular story that you should be here this morning.

Dr. Dolman: Yes, it is pure accident.

Senator Cameron: We are trying to find out the role between the science secretariat, the science council, and all of these other agencies. I must say that the lines of demarcation are not entirely clear to me.

Dr. Dolman: No, they are not to us either.

Senator Cameron: So if a substantial number of the participants in the symposium of the Royal Society were not in agreement with your recommendations, then it would be a serious matter.

Dr. Dolman: Yes.

Senator Cameron: I can understand the differences because, having lived in an academic community all my life, I know how faculty can disagree on a lot of minutiae.

Dr. Clark: If I may intervene again as an outsider here, it seems to me there is not a contradiction. It seems to me there is double concern here on the part of the science community. Again I am speaking very much as an outsider.

Senator Grosart: If I may interrupt, Mr. Chairman, four of us have to leave to attend another meeting. I would like to make it clear that it is an imperative meeting that we have to go to and our leaving is in no way intended as any disrespect to the distinguished witnesses. We will try to get back as soon as we can.

The Chairman: I understand it is a very important party caucus.

Dr. Clark: I think the main thrust of this brief, as I read it, is urging for a strengthened science council that will offset the danger of science policy becoming more and more determined by the science secretariat. I don't think it contradicts the discussions the other day.

The Chairman: I think also in fairness to the report of the science council, while I pointed that out to them myself here when they were before us on this Report No. 4, that they left out quite a number of things, and they admitted this. That is probably what justifies the title "Towards a National Science Policy". But they said also, if I recall correctly, that what they call small science, which is in this case more or less identified with fundamental and curiosity research, that this would be continued. They are strongly in favour of that. So there might have been some confusion among your own members as to the real objective of the science council. They may have lost the few sentences which were devoted to that subject and were impressed perhaps by some other press reports emphasizing these major mission-oriented programs.

Dr. Dolman: Yes, I think that is probably true. To express considerable opposition at the outset seemed better than having to mobilize it later on, so that if this was indeed a trend, our position was clear from the beginning.

Dr. Lortie: Mr. Chairman, this is a reflection of something that is going on around

the world because of this debate between pure and applied science, and mission-oriented and curiosity-motivated research. It is something we read about in England, in France, and in the United States, everywhere at the present time. So I know, and we can feel for them, that the academics are very much concerned with this situation, because they are afraid there will be less money for them and that will dry up the source of applied science and technology. They have a duty to perform also towards society by training the academics who will follow them. If they cannot do that in the universities who else can do it?

Then on the other side of course we need more applied research, so that our own technology will come up with more innovation. As we have said in our brief, it is a continuous process from the curiosity-motivated research to applied research and technology.

The Chairman: Perhaps it is a difficult decision to take as a nation but the figures we have at present, and which I have quoted on various occasions, are to the effect that we devote about 63% of our R and D effort to R, to fundamental and applied research, and only one-third to development, while in the United States and Great Britain the proportions are just reversed. Science development is quite important too in terms of problem solving in the fields of economics and social policy. We may have to put a new emphasis in our national effort, favouring more development work in Canada. And the United States may have to move the other way and give more attention to basic and applied science.

When we were in Washington, Dr. DuBridge, the new science adviser to the President, has now become the sponsor of a proposal which would really increase the American efforts in the field of basic science quite rapidly. The figure he was quoting was at least 10% every year from now on, which would be a change of orientation for American policy.

Dr. Dolman: I would not wish it to be thought we are not in sympathy with the need for greater expenditures on development. This is indeed clearly stated in the brief. It is simply that we cannot afford and cannot approve as a Society—and I think this is a real consensus among us—of any trend that downgrades the significance of fundamental research.

Senator Cameron: I think the chairman is right, and I don't think, as far as this committee is concerned, they need have any worry, but I am wondering if one of the reasons the academic community may be excessively concerned about a possible downgrading is because the word is getting around that we are not doing enough in the development area, that more funds must be allocated in that sector, and they are automatically jumping to the conclusion that this may be at their expense? I think we must be sure that this does not happen.

Dr. Dolman: I think if this could be made clear, not only to the public but to the scientific community, there would be less unrest and concern.

The Chairman: There is another thing which has been intriguing us, at least it has been intriguing me, especially since we have been to Boston where we met with Professor Marquis of the school of medicine at MIT. He is a great student of the whole innovation process. He was telling us that the basic and applied research tended to produce to a large extent more knowledge, and that this kind of scientific activity tends to be more or less parallel with development work, that those who are working in the field of development work do not have daily contact with the scientists at the upper level, that it takes on the average about 25 to 30 years for basic research to be transformed into new technology, while it takes on the average perhaps about 8 years for new technology to be transformed into innovations. He added that engineers very often were not great readers and did not read very much about what the scientists had to offer to them in terms of new knowledge, and that this diffusion of new practical knowledge was made through personal contacts rather than through scientific journals.

I wondered if you would like to comment on this because this is intriguing also when you try to bring your national science into more balance?

Dr. Dolman: My first tentative comment, sir, (and this cannot under the circumstances be a considered opinion, because it is an unusual question), is that the enormous amount of potentially fruitful ideas that are evolved by the basic scientists cannot even be kept abreast of by themselves. For example, it is impossible to read all the literature not merely in my own specialty, microbiology, but even about one particular microorganism.

One cannot keep up to date with it nowadays. The hiatuses between the man making a discovery at the laboratory bench and the man who finally shows how it can be adapted to a new process, and the man who makes a profitable business out of it, are bound to take time to bridge. Those engaged in the development process are usually employed by firms and have no particular need to try to master all the literature because they have a clear goal.

I think there is, in other words, a vast fermenting mass of information at a basic level, of which only a small proportion will ever come to be applied in new invention and discovery. Those who get assigned to development will consult only with a certain number of selected people, rather than go delving into the literature.

Dr. Lortie: The Society has never discussed that problem officially, but you can find some reference to ideas of that kind in the volume which I think we sent to all members of the Senate and the House of Commons. That is the reprint of the symposium on scientific research in Canada which was held in Calgary last year, where you will find at least two papers dealing with that very question, one by Dr. Gaudry and the other by Dr. Duckworth.

These are ways and means by which there will be a closer relationship between university research and industry and also towards innovation and technology. Then there is the part that can be played by different governments, and some programs which could well be joint university and government projects. There are a number of ways and means to do that. These are not exactly the views of the Society but they were expressed by two members of the Society, one of whom Dr. Duckworth, is the second vice-president this year, and Dr. Gaudry, who is a member of the science council.

The Chairman: Dr. Gaudry has been before us twice.

Senator Cameron: Mr. Chairman, I do not want to switch this topic if there are other questions in this particular area, but I would like to get into another area and this concerns the humanities. I see a sociologist here whom I know very well.

The Chairman: If you will allow me, I still have a few questions on this part of the brief.

Senator Cameron: Yes.

The Chairman: I would like to go on with our discussion as to the science council. Would you, for instance, favour some proposal that the officials of the government or heads of research institutes should not be members of the council? As you know, they are now. We have heard some criticism about this and we have had suggestions that the science council should be composed only of outside people.

Dr. Dolman: My spontaneous reaction to this would be that it would be very undesirable to cut them off from advisers in universities and industries. I think the more collaboration and discussion between these various representatives of different bodies, government, industry and university, the better, provided it is perfectly understood that each man can speak his own viewpoint. I think it would be very unfortunate indeed not to have the science council fully representative of all those involved. I am rather surprised that this question has been raised.

The Chairman: Well, we might deal with some other aspects, perhaps as to the influence the United States has in Canada. In the United States, as you know, they have two parallel organizations, one for the government, for government officials, and the other being the National Foundation. This has been suggested quite often here to us, that there should be a separation and that the science council should be composed only of outside advisers.

Dr. Dolman: As far as I recall, the government science representatives, if you can call them that, are in a considerable minority, are they not?

The Chairman: There are a fair number.

Dr. Dolman: Associate members, I think.

The Chairman: There are four associate members.

Dr. Dolman: In addition.

The Chairman: In addition, yes. I think it is about one-third each, one-third government, one-third university, and one-third industry.

Dr. Dolman: Well, I would not wish to express satisfaction with the proportions necessarily, but I certainly think there should be representation from all these bodies.

The Chairman: All right. I think that is all on this part of your report as far as I am concerned. Senator Cameron.

Senator Cameron: One of the things that is very noticeable all the way through here in the discussion we have had so far is that no one has been making any very specific recommendations with respect to the role of the social scientist. I wondered if we might get into that area for the moment. The Macdonald report recommended that a social science council be established as one of the three.

I am wondering, Dr. Clark, from your background do you see this as an effective troika in terms of the mechanisms that will provide the most effective advice in formulating science policy for Canada?

Dr. Clark: The brief here, Senator Cameron, I think comes out very clearly in favour of the maintenance of the present establishment as far as the Canada Council is concerned. I think Dr. Daniells will make very clear that this is overwhelmingly the view of the humanists in the country. I would have to say that the social scientists, perhaps as in the case of the scientists with respect to the science council, have not a clear view on this matter—the separation of the social sciences and the humanities from the arts and the establishment of a separate council, or the maintenance of the present Canada Council. My personal view would be to leave things as they are and not upset the Canada Council as it is presently working.

Senator Cameron: The suggestion has been made to us, and I think this is correct, and this is not a criticism of the Canada Council, for which I have a high regard, that, because it is now supported predominantly from federal appropriations, this was not provided for in the terms of the original act setting up the Canada Council, and if we preserve the Canada Council as the funding agency for the social sciences then it may be necessary to revise the act.

Dr. Clark: I think the hope would be that the politician would think in voting money to the Canada Council that he was supporting the arts, and the arts are a good thing, and not concentrate attention on the social sciences and thereby invite more and more curiosity on the part of the politician as to what the social scientists are up to. For that reason I think we would come out in favour of the present establishment.

The Chairman: Oh, I think you are too timid in the light of what went on when I succeeded in convincing my colleagues in the Cabinet. The proposal advanced, and which was accepted by Cabinet, was to increase assistance to the social sciences and the humanities, not the arts.

Dr. Clark: I would concede that, Mr. Chairman.

The Chairman: And Cabinet ministers are parliamentarians too.

Dr. Clark: My fear though would be that once you call it a Social Science Council then you invite much more attention. As long as you call it the Canada Council...

The Chairman: Well, I don't accept that. I think it is wonderful if it attracts much more attention. I don't see why the social sciences and the humanities should operate in secret.

Dr. Clark: I am not suggesting that they ought to operate in secret, but I think again they ought to operate with a good deal of independence.

The Chairman: Oh, of course.

Dr. Clark: I think there is that danger.

Senator Cameron: Well, the reason this is very important to this committee is that I think the consensus would be that in the future we must greatly increase the funds available in the realm of the social sciences, particularly in connection with housing, urbanization, health and all of these other problems, including pollution. There is an astronomical need in this direction.

Can this be done under the existing Canada Council legislation legally and legitimately? And that is one aspect. The other aspect is, in recommending a science policy for Canada, we are concerned with recommending the mechanism that will be most efficient in making these funds available. I am not sure in my own mind at the present time whether it is better to accept the Macdonald recommendation or not, but we must have some answers on it. And you are the first victim we have had specifically from your area in this.

Dr. Clark: Again I am anxious that Dr. Daniells express his views because I think there is a very clear difference of view here between the people in the humanities and the people in the social sciences. Certainly, to answer your question, it would be the view of the social scientists in terms of efficiency in

directing funds into research in the area of the social sciences that it would be better to have a separate council.

We are concerned a bit, I think, and this is a concern that goes back a long way, as you know, to the establishment of a social sciences research council, and to one of its chief founders, Professor Innis, who today would turn over in his grave at any suggestion that a social sciences research council should be dependent upon governmental funds.

The Chairman: Yes, but we have moved a long way since Dr. Innis said that he would never be a member of a Royal Commission and then he became the chairman of one.

Senator Cameron: Could we get Dr. Daniell's views on this because this is a pretty important issue?

Dr. Roy Daniells (University of British Columbia): Mr. Chairman, there are two points of view, I think. One is that it must be recognized that the sciences on the one hand and the social sciences and the humanities on the other have a totally different aura. The sciences are not ideological and almost any result that comes from scientific research that is highly successful the public would like more of. On the contrary the social sciences and the humanities get into matters of relations of race, creed and class, with every sort of inflammatory issue by implication or directly. Therefore for the humanities I can say with authority, because I have circularized every member of the Royal Society having any interest in the humanities, there is absolute unanimity in wishing to keep the present structure of the Canada Council intact and operating under the very effective shield which it has hitherto provided and promises to provide.

If, for example, a book is published which has matters which might be brought up in Parliament, the Canada Council has a very delicate and effective mechanism for giving its support without accepting overt responsibility. The book is published, the Canada Council's hands are clean, the money is provided, everything is dead right. We don't want to see that upset and something more authoritative, but proving less effective, put into its place. That summarizes the views of all the humanists I have spoken to in Canada.

The Chairman: I do not see why that kind of procedure would have to be changed under the auspices of a separate council.

Dr. Daniells: Separate for the humanities.

The Chairman: Separate for the humanities and social sciences.

Senator Carter: I think they would be endorsing this particular ideology in the book if they put up the money for it. That is the point, I gather.

Dr. Daniells: There is a natural and logical desire to have the Canada Council above ideological disputes but nevertheless to have it support the kinds of research that might be interpreted as supporting one or another ideological point of view.

My chief feeling personally about the Canada Council is that it works so well and if legislation were introduced to change it, there might be delays, particularly delays in granting funds, of two or three years, and that the whole operation would be, as it were, derailed.

The Chairman: Why should this happen?

Dr. Daniells: It always does, doesn't it? That is, the gap between the implementation of a new policy and the granting of funds to have that policy operative is likely to take 24 months or 36 months in parliamentary...

The Chairman: I don't see why. If the government were to decide to change this and have new legislation, it might take that time, but I don't see why during that period they would have to stop advancing the money which is available to the Canada Council. It does not seem to follow.

Dr. Daniells: There is still another reason and that is if arrangements were set up which appeared to connect the federal government with specific social research, educational research and matters of this kind, it seems highly probable that in at least three of the provinces demands would be made to hand the funds associated with this research over to the provinces for their own disposition. I am speaking for my own province, British Columbia. I would be extremely reluctant to see that happen in British Columbia or elsewhere. All these are considerations which have entered into this.

The Chairman: I want to come back to this because this argument is contained at page 29 of your brief, this last argument you have just put forward, and it is not the first time I have heard it. However, I am far from being convinced by it. I think it is a non-sequitur. At present we have in the province of Quebec,

as Dr. Lortie knows very well, a minister of cultural affairs who is asking for that very thing now. I am glad to know that the federal government now has learned to say no.

However, I do not see what would be the change. The federal government under our constitution and the traditional interpretation of that constitution is clearly responsible for research over the various disciplines. I think that the constitutional responsibility for research, including research in the social sciences, is much clearer than assistance to the arts. So I do not see why you should be worried. Maybe the authors might be worried because their case is less clear. I still maintain this is a proper function of the federal government. It is much clearer as far as the humanities and social sciences are concerned.

Dr. Daniells: Could it be discovered what the objection is at present to the present function of the Canada Council which to the humanist's point of view is very good indeed? That is to say, who objects to it and for what reason?

The Chairman: One of the reasons which has been given to us is that as the money available to the council increases it will become more and more difficult at the level of the council itself to make appointments and to try to cover the whole community which is involved, including the humanities, the social sciences and the arts. That is one objection which has been put before us.

The second one is that allocating money for orchestras and ballet and all this is quite different, it is a quite different operation from allocating money for research in the social sciences or in the humanities. These are two objections which have been presented to us.

Dr. Daniells: Speaking as one who for quite a number of years has served on Canada Council committees in connection with the humanities, it seemed to me their mechanisms even in those days were admirable in their simplicity, in their economy, in their effectiveness and in their fairness. One is astonished always to see things work so well. And, so far as one could gather in the other areas of the performing arts and the social sciences, equal degrees of competence and effectiveness were obtained. I suppose, to put it in one phrase, the average humanist in Canada is a bit aghast that anything that works so well should be disrupted, feeling that it is an organism that he grew up with

and what would he find in its place. I would think that is the emotional reaction we have.

Dr. Clark: Mr. Chairman, I think the social scientist is placed in somewhat the same dilemma as the scientist. I think the social scientist recognizes and indeed has long recognized, and this is a view expressed over and over again, that it is a pretty silly business for the Canada Council to be trying to decide whether it is going to give money to a symphony orchestra or to a piece of research in the social sciences. And yet I think there enters another consideration here, which I fear you don't accept...

The Chairman: I may be completely wrong; I have been proven wrong before.

Dr. Clark: Let me say it is a matter of history. The Canada Council was founded independent of government grants and developed a tradition of independence.

The Chairman: I know the origin of it.

Dr. Clark: Yes. Now it is not clearly threatened even though it has become dependent upon government funds, but I think the fear of the social scientist would be that once steps were taken to create a social sciences and humanities research council the interests of this council, the thrust in terms of the kind of support it would be given, would be more and more drawn into and related to the interests of governmental departments, of the government itself, and that it would become by the very act of creation much more an agency or tool of the government.

The Chairman: I think there is no basis for this in our Canadian tradition. We have had all kinds of research or other organizations which have operated completely financed by government and which have remained completely free. I don't say that this is a guarantee for the future, but take NRC, they have operated what was more or less a kind of university for years without interference. The CBC certainly has operated quite freely, quite independently from the government. So we have a long-established tradition of that kind of respect for the freedom of those institutions which need that freedom.

I think if there were parliamentarians or politicians trying to interfere with the activities of the CBC there would be a revolution somewhere, as we have experienced in the past. I do not see any fear of this. Perhaps before, when we had not had enough experience in this field, perhaps then the fears were

justified, but I think with this long experience, as far as I am concerned anyway, and I am a social scientist too, I am not afraid of government.

Senator Cameron: Mr. Chairman, I think we would all agree that the arrangement under which the research in the humanities has been financed under the Canada Council so far has worked quite well, but I think we would be naive if we thought that as the funds are enlarged for this purpose, even under the Canada Council aegis, we are going to escape criticism, because if you look at the Toronto Telegram, it has had articles very critical of some of the grants that were made. In recent times there has been great criticism of some of the scholarship or assistantship awards. I don't want to get into that field. I will leave that apart for the moment.

When you get into the areas of tremendous moment, the old question of pollution and health and that sort of thing, you cannot escape criticism, I don't care what auspices you are under. We as a committee have not discussed this but the very fact it is in here as a recommendation from the Macdonald group means we have to discuss it and probably we will have to take some stand on it. So we are anxious to get the benefit of the advice of the people who are directly concerned. We would like to get your very frank assessments. You have been very frank, Dr. Daniells, and we appreciate this.

The Chairman: That is the purpose of this exercise.

Senator Cameron: Yes.

The Chairman: If it is not an exercise in frankness it is useless.

Dr. Daniells: When one reads a criticism in the newspapers directed against the Canada Council for a special grant to a specific person—we can name these—my feeling is one of relief and thankfulness that they have a tradition and Jean Boucher who is incorruptible is there. Look at all the thousands of grants they have made that have worked. You have armour-plating that thick in terms of performance, which deflects this kind of attack.

If you set up something new and more specific, more narrowly based, more concerned with issues which are inflammatory, then perhaps that would be more vulnerable. Such is our feeling. I do not say that the view I am expressing is exclusively correct. I only say I

am reflecting the normal feeling of the humanists.

The Chairman: I think that Dr. Lortie wanted to make a comment.

Dr. Lortie: I would like to make a few comments about that. I think Dr. Daniells has already answered the question as to grants to both the academic on the one side and the artist on the other. There are, however, some fundamental points I think are very important here.

The first one is that the Canada Council is less vulnerable than the Research Council which has been attacked, because it does not have its own laboratories or its own operations, it is only a granting agency. I do not agree of course with the proposal—this is my personal view—of splitting the NRC into two different operations.

The other point, I think, is also very fundamental. I am not here to represent the Canada Council, although I am a member of it, but, seeing how it works, I think it would be a pity to change it right at the moment when it is giving much better service to the humanities and social sciences than it has done in the past, because it has more funds to dispose of; and the mechanism through which these funds are allocated to different persons or institutions is working well. So that they have built up and are still building up, a very good organization through which these applications are analyzed and submitted to different persons on the academic panel or the arts panel, and then to the academic committee, and then to the whole council. It works very well.

Then the most fundamental point is this, that in the future we can envisage a lot more leisure—excuse me, I am a scientist at the same time—technology will give us much more leisure. That means that more economic and social problems will be created. These social problems should be studied by the social scientists. I think these social problems include a lot of things like the arts, for instance, and the arts are a part of our modern way of living for the masses, and I think the Canada Council in the future, if it stays as it is, will have a much closer view, an overall view, of that situation, if they analyze the social structure and the social problems, and attempt to remedy some of these things.

The Chairman: They cannot do that now. They are just a granting agency responding to the applications.

Dr. Lortie: There is a link between some social problems and the arts, let us say, for instance, in the humanities, where you have the two problems, one being the academic problem of research in the humanities and the other the creative side. This is dealt with on two sides of the Canada Council. They are well interwoven. So that the humanities would be deprived of one aspect of their duty if there was on the one side a social sciences and humanities research council and on the other the arts and the creative writers. Would you agree?

Dr. Daniells: I agree with that.

Dr. Lortie: And there is the same thing with music as well. You know something about that, Senator Cameron, with your Banff School of Fine Arts. This is part of an academic community. At the same time you have creative arts and the performing arts there, so there is a direct link between the two. I do not think it would be a good thing for the future of Canadian culture to divide the Canada Council into two units which would become completely separated.

The next point I would like to make is something that is contained in our own brief. You spoke about pollution. Pollution is at the same time a social problem and a scientific problem. That is one...

Senator Cameron: Interdisciplinary.

Dr. Lortie: Yes. We would like to see, if there is any change to be made in the science council, that there would be some people who would be able to interpret as between the various disciplines in these matters. I mentioned pollution, but there are others. It is very important to see that there is one unit which would look after these things with collaboration, coordination and correlation of all its work, trying not to build up a pyramid which would be quite amorphous.

Dr. Clark: I think, Mr. Chairman, it is apparent that the social sciences do stand in a somewhat uncomfortable relationship here. Perhaps I should not use the word uncomfortable, but they do not fit as neatly into the Canada Council as do the humanities. The social sciences of course have indeed looked at the science council with some thought that the science council might be broadened and made to represent the needs and interests of the social sciences as well as the sciences.

I think that is reflected indeed in the fact that Professor Daniells can report the

unanimous view from the humanities people with respect to the maintenance of the Canada Council, whereas in the case of the social sciences it is not anything like being so unanimous.

The Chairman: To come back to what Dr. Lortie was saying a moment ago, he was saying that he is against the separation of functions within NRC, and I can well see his point. By implication he wants to have a federal agency for the physical and life sciences doing in-house research in these fields and at the same time granting money to universities and industries for these purposes. If we pursue this analogy, doctor, when we come to the social sciences (and I am not speaking of the humanities because I know less of this field than the field of the social sciences), we have the Canada Council giving grants to universities, to individuals really and not so much to institutions, but there is no comparable exercise within the federal field that is accomplished by NRC for the two other great groups of scientific disciplines.

It seems to me that there is a gap, and this is a great gap because, as we know now in this committee, the level of research in the field of the social sciences within the different departments is very practical, as it should be; it is very devoted to what I would call, using the analogy of the other disciplines, development work. And then we have the Canada Council giving money for research, so-called fundamental research, in the social sciences in universities. But there is no agency within the government now doing a job which would be comparable to NRC for the social sciences.

I think that the social scientists will have to look at this situation very closely, because if we are not careful we will see very soon a kind of multiplicity. Rather than having a good institution within the government doing that kind of thing, and doing it properly and effectively and with excellence, we may wind up having all kinds of different institutes, which would be much worse than the present situation.

The government is seriously considering an institute, a research institute, for external aid, or international development, as they call it, I think. There is already a proposal circulating to set up a research institute on transportation economics, and things like that. As you know, there is another project where Mr. Ritchie now has been asked by the government to develop some kind of proposal to establish a research operation in the field

of the social sciences. As far as I can understand his assignment, he has been asked to produce some kind of agency which would minimize the necessity for the government to establish royal commissions. This would not be my concept of a research centre of excellence in the field of the social sciences.

I wonder if you have some comment on that? And if such a centre of excellence for the social sciences is considered to be desirable, then I come back with Dr. Lortie's thesis saying "Well, this council should also distribute the grants".

Dr. Clark: Mr. Chairman, I think I have been stressing here the importance of the active creation or how this thing comes about. I would find myself completely agreeing with you, providing the proper safeguards were taken.

The Chairman: Oh, of course.

Dr. Clark: That this is what is indeed in the social sciences. I think that the problems here are very different from the problems in the humanities. I think the humanities operate much more in terms of policies of a granting agency, whereas an economist may be doing something in a university or may be doing something in the department of agriculture, which is not very far apart. There is not the same problem in the humanities. I think the problem here is a very different sort of one. I suggest the social scientists are just a little fearful of the balance shifting over here so much from university research to in-house government research, that this might be damaging to the position of the social sciences in the country.

The Chairman: I do not think they need to fear this because we do not need to repeat—although it was a great experience for Canada—the experience of NRC 50 years after the event.

Senator Cameron: Mr. Chairman, obviously this Macdonald group was set up by the science council.

The Chairman: And the Canada Council.

Senator Cameron: And the Canada Council. And they interviewed people all over. I assume, Dr. Daniells, they must have interviewed the people you represent and the people you, Dr. Clark, represent, and they have come up with this recommendation which, as far as your present statement goes, is completely against everything you want to see

happen. How could they make a recommendation of that kind?

The Chairman: No, they are not speaking with the same voice.

Senator Cameron: I know that.

Dr. Clark: I might report confidentially here that the University of Toronto provided two briefs to this committee. In the first brief they advocated very strongly the division of the Canada Council into two separate bodies. They wrote a revised brief and said exactly the opposite.

Senator Robichaud: After second thoughts.

The Chairman: Sober second thoughts.

Dr. Clark: After a visit from Dr. Boucher.

The Chairman: Perhaps one way of reconciling these different points of view would be to have a separate council for the social sciences and leave the humanities with the Canada Council.

Senator Cameron: I think there is a good case to be made for this. However, there is one thing, Dr. Daniells, where a criticism was made to us, and this was from the university administrative standpoint, that a dean will say to one of his staff, "I would like you to carry out a certain piece of work starting next month." But that member of the staff says, "Oh, I have a Canada Council grant. I am going to Europe." And this was the first the dean knew about it.

Dr. Daniells: Oh, sir, I think at least the mechanism for obviating that has been in operation. Before the application can go in there is a dotted line on which the dean or other person in authority must signify that the applicant can have leave. That is very important.

Senator Cameron: I am aware of that, but the suggestion has been made before this committee that this has not happened.

Dr. Daniells: Then I think the dean should take action on that one.

Senator Robichaud: An oversight.

Dr. Lortie: The question now is that most of these grants, you see, are part university and part Canada Council's, so that the university knows something about it at the present time.

Senator Cameron: It is a difficult problem. We are looking for guidance because we obviously will have to pay some attention to the Macdonald report. As I said earlier, we have not discussed this as a committee but I think it has been lying in the back of our minds, "When do we come to this?" This is the first opportunity we have had really.

Dr. Lortie: The Canada Council is learning its job now while the NRC has been doing its job for many years, so that a lot of things are going to be improved, and very soon. They are already improving and will improve more with time.

Dr. Daniells: I would agree, sir. I think some of the elements of criticism in the brief, which I introduced, about the Canada Council, are no longer applicable because they have already been responding. There is a continuous self-regeneration in a very salutary way.

Dr. Dolman: If I might interject at this point, Mr. Chairman, I would say that the science section of our Society yesterday went on record as being strongly opposed to the recommendation of the Macdonald report that would have split the NRC's functions. I think this is a matter of information and that this is the proper time to mention it.

The Chairman: We are glad to have this because I did not know that.

Senator Cameron: Would you, Dr. Daniells, and you, Dr. Clark, be satisfied if the humanities section were left with the Canada Council and the social sciences part of it were set up somewhat along the lines of your recommendation?

Dr. Clark: Again I think I would have to report that you would find opinions divided among the social scientists.

The Chairman: Apparently it depends on the visitor.

Dr. Clark: That's right. There is a sense of loyalty to our old buddy. We talk about the humanities and the social sciences. Perhaps Dr. Daniells would object to this suggestion, that we do not want to let the humanities down.

Dr. Daniells: Far from it.

Dr. Clark: But I think there is that feeling among the social scientists, that we would be a little reluctant to split off.

Dr. Lortie: There would have to be a very clear definition of what the social sciences are, history, philosophy, geography, wherever they belong.

The Chairman: We have the same problem with all the disciplines. There are always gray zones.

Dr. Daniells: History, for example, and the various disciplines which now cluster under what used to be geography, are so ambivalent that to attempt to chop them up would seem to me again to devitalize them. I would agree that it is very much better, if we possibly can, to hold the two under one roof.

The Chairman: We have the same problem now when we see, for instance, psychology is supported by NRC and by the Defence Research Board.

Dr. Lortie: I think in the future we will depend much more on interdisciplinary research.

The Chairman: Did you have something, Dr. Clark?

Dr. Clark: I was going to adopt what you said, Mr. Chairman, that there are certain disciplines like psychology, anthropology, and indeed geography, that have clearly moved over to the other side.

The Chairman: Yes, and I think this is undesirable.

Senator Cameron: I think you can see the kind of massive headache we have in front of us.

Dr. Lortie: You will become a university president yet.

The Chairman: Or chairman of the Canada Council.

Senator Robichaud: The questions I had mostly in mind have been covered in this last fifteen or twenty minutes discussion. However, may I say in passing that I am pleased to see that a society known as the Royal Society of Canada is giving special attention in its brief to research in French Canada and to situations pertaining to research encountered by Francophone scholars. After outlining some of the progress which has been made in this field it states at page 25 of the brief:

Notwithstanding these advances, they are far from meeting present needs, let alone the foreseeable greatly expanded demands. Much costly human and materi-

al effort is disproportionately diverted to the teaching of elementary techniques, already familiar elsewhere. Moreover, though research activities are quite well organized in some sectors, they lack overall coordination. Great benefits might come from a central organization, whose functions would be to stimulate and coordinate research endeavours; to assign research teams to priority projects; to avoid costly duplication and overlapping; and to ensure the equitable and prudent distribution of funds.

In speaking of costs I presume that, as in the case of all the other organizations which have been before us so far, federal funds are mainly involved. My question would be, could we have comments or more details on the type of central organization that is envisaged here?

The Chairman: This has intrigued me too.

Dr. Lortie: It has intrigued me too because it has come from Section I, of which I am a member. However, being president until yesterday, I did not have much chance to discuss that. But I envisage it, if I interpret it correctly, as being a closer liaison between the Canada Council, if possible, and the Minister of Education in Quebec.

Senator Robichaud: Is that possible?

The Chairman: I am a member of that section but I was not there when this was discussed. My brother is the chairman of the section. I wonder if this is the right interpretation. I don't know.

Dr. Dolman: This wording, if I might interject, is a paraphrase of the submission from Section I, Section des lettres & sciences humaines, and I took it at the time that they were referring to all sources of funds, not necessarily federal only.

Dr. Lortie: Yes, that is the point. I know something of the situation of course. There is not very much relationship between the research communities, particularly in the social sciences and the humanities, in our French universities in Quebec, as well as in New Brunswick and elsewhere, and I would include the University of Ottawa also, which is a bilingual university, as well as the University at Sudbury. They are only beginning. There is a dearth of graduate students. There is also a dearth of research professors because they are confronted with so many students at

the present time. I don't know how they will be able to come to a good and valid research program until they have the proper ratio of professors to students. There seems to be employment for all of them, so that very few of them in the social sciences and humanities go up to the level of research except in psychology.

In the case of our own university at Montreal it took a long time before our department of psychology could produce doctors. Then in the last few years there have been 20 of them. But many of them started in research many, many years ago. So it is a question of organization there. They had too few professors, but now they have enough or approximately enough to supervise all the thesis work. The same thing must happen at Laval University. Sherbrooke is another example. It is a young university.

There is a need and they are trying in Quebec at the present time to fill this gap with a survey of all the research work that is being done in the universities. There is a splendid volume produced every year now to indicate what kinds of work are being done here and there. That way there will be no duplication.

The Chairman: But this is really a vague statement. It would certainly need more clarification. This is a section here devoted to French Canada, and French Canada is not limited to Quebec. Then there is this statement about coordination. I do not really know what it means. It is for more coordination, but we do not know what to coordinate.

Dr. Lortie: I do not know whether you have been supplied with the brochure that has been published by the Royal Society's Section I, on *La Recherche au Canada Français*. If you have not received it yet, the Royal Society could gladly provide it for you. It would give you a good idea of the present state of research, not only in the humanities but in the social sciences and the natural sciences as well. I think that would be quite important, that you read that.

The Chairman: We would be delighted to receive it.

Dr. Lortie: You will get a much clearer idea than from the brief.

The Chairman: To be able to understand this mystery this morning we will have to go to the authors of that section of the report.

Finally, as far as I am concerned at least, I would like to raise another issue directly related to the Royal Society. When we were in Washington we were quite impressed, (and this was repeated also in Boston at Harvard), with the relationship which existed between the parliamentarians in Congress and the Academy of Sciences in the United States Congress is relying to a fairly large extent on assignments that it asks the Academy to undertake and to report back to them. I do not think that we have had a similar experience here. I do not see any other institution than the Royal Society of Canada to perform that kind of role, if that role is desirable in Canada. Would you care to comment on this?

Dr. Dolman: Yes, very gladly, Mr. Chairman. I think it is quite true to say there is a marked distinction between the role of the National Academy of Sciences in the United States and the situation here. In the United Kingdom, for centuries the Royal Society of London has customarily been consulted by the highest authorities about scientific issues of national significance. As far as I know, the Royal Society of Canada has not been consulted in this sort of way, except through individuals who might have held appointments in spheres that made it obligatory to consult them.

One of the main objectives in our submitting a brief, one of the main resolutions that has permeated the society in the last few years, aims at the assumption of a more effective role, to the extent of our capacities, in opportunities to advise and to help formulate policies that affect the nation at large. We have nothing to gain personally thereby and we do not wish to aggrandize ourselves as individuals in any way whatever. We do feel, however, that constitutionally and through the very method of electing our fellowship, the Society should have, the capacity to be a useful advisory body. We would greatly welcome the opportunity of serving in this way, even though at the beginning the venture might be experimental, as it were.

I believe that we could effectively and fairly promptly give helpful opinions on the sorts of problems that have been troubling the senators in the discussions we have had today. I must say I have been tremendously impressed by this experience, particularly from the standpoint of the evident difficulties, crystallized by the discussions we have had, and of the problems that face us all as Canadian citizens.

I think we could quite profitably spend a few minutes if there were any questions that any members of the committee might wish to direct to us respecting the means by which we could meet and formulate our opinions on problems that you might care to present to the Society. I do not guarantee that we could answer your questions, but we would be delighted to try.

Senator Cameron: I presume, Mr. Chairman, that when we start crystallizing some of this material we might want to do just as Dr. Dolman suggests, to call in various competent people for advice on some specific topics.

The Chairman: I was impressed when we were in Washington and particularly again at Harvard when we heard Dr. Brooks, who has been very close to this society...

Senator Grosart: You have always been impressed with Harvard.

The Chairman: Oh, yes. In the United States they have done most of the studies that the science secretariat here and the science council have done. The relations between the titles of the two series is quite impressive. I do not want to say that the science secretariat was hired by Washington but the correlation is very high.

The difference is that in the United States most of these studies have been made by the Academy under contract. Here they have been done under the auspices of the science secretariat or the science council by organizing a special group for that purpose.

I was wondering what advantage we would have in perhaps changing the procedure here, so that instead of having the science council or the science secretariat organize a specific group for a specific study, whether or not it would be better to go to the Royal Society for this? I know how well-equipped you are and what kind of easy consensus you could reach. We all know that we are living, especially in science, in a pluralistic society, but when these studies are made it is expected by the politicians from this pluralistic society that there will come finally and hopefully only one voice. I wonder if you could operate under those circumstances?

Dr. Dolman: I think it would be fair to say that, while our members are usually extremely busy people, if we were set a problem of a specific nature we could call together an ad hoc committee that would be as good as any that could be mustered in the country. By

definition we ought to be able to do that. And we would do it with a will and go at it until we had come up with a solution that was satisfactory to ourselves at any rate. I believe we would arrive at a consensus. I just wish to assure you, sir, and the members of your committee, that we should be glad to have the opportunity to attempt this.

The Chairman: For instance, with regard to this study on physics, do you think it would have been better if the science secretariat had gone through you or with the committee that is set up? That is perhaps an unfair question.

Dr. Dolman: That is difficult to answer because I do not at the moment know the composition of that committee, but I think they would not have lost any time or any final value in their report if they had consulted with us, which they did not in fact do.

Senator Grosart: Mr. Chairman, if we followed the American pattern this committee could join the club and become a fund-granting agency.

The Chairman: Well, I would be quite prepared to join that club because these congressmen have a staff of 10 to 11 people. I would like to have that too. Their committee on science research and development had 22 full-time professionals who advise them. Here we have only 1½.

Senator Grosart: That is the subcommittee that has that.

The Chairman: Do you have any other questions?

Senator Grosart: This question may have been asked in my absence, Mr. Chairman. I am wondering what the facilities of the Royal Society are in terms of manpower and money to undertake the type of study that is suggested?

Dr. Dolman: They are meagre enough, sir. We are already in need of funds, which we are trying to increase by levying this very year a double annual fee from our fellows?

The Chairman: I noticed that.

Dr. Dolman: It hit you personally, sir. Also by seeking increased grants from the Canada Council, which currently provides \$10,000, which is being increased to \$15,000, and from the National Research Council, whose grant we hope next year, but not this, will be increased from \$17,000 to \$25,000.

These are small enough figures. It gives us a total budget for all our operations of the order of \$80,000. This is of course not enough to launch elaborate surveys or anything of that sort. What we have in mind at the moment is to increase our central office secretariat, to strengthen it, by having at least a suitable executive officer who would preside there and represent the society fittingly and increase the efficiency of our operations. We are short even of stenographic staff at the moment, which would certainly have to be increased before we undertook anything new.

I feel that we do have enough at the moment, with the promised increases, to enable us to undertake special meetings of such an ad hoc committee as I referred to, in the event we were asked to give advice on a specific problem. It is a matter of gathering together the right people in Ottawa or some other centre and having their report typed out for distribution. That sort of thing we could undertake with very modest increases in expenditure.

The other project I mentioned at the outset, of being in a position to give some coordinating leadership to other learned societies, would of course involve an increase in our central office staff, which might require another budgetary increase of the order of \$10,000 or perhaps more, exclusive of the executive officer. In other words, our needs are rather modest in the light of what we feel we could do with these increased funds.

Senator Grosart: In other words, any specific project reference to the Royal Society should be accompanied by a grant or a contract of funds?

Dr. Dolman: A contract of funds to cover the mechanism of producing the report, not in any way to reward those involved in the preparation of the report.

Senator Grosart: Except for the present staff you would have to engage additional research staff, if you were going to make any kind of a contribution to the present knowledge of the subject if there was a special reference to you.

Dr. Dolman: I think that is true. I should add to that that we would not happily contemplate the collection of data on the scale which is already being done by these other bodies. This is another matter, of a different order of magnitude. If it is a question of getting a consensus and a collective opinion

on a specific project, that we could do with sufficient to cover travel expenses of the fellows concerned plus secretarial costs.

Senator Grosart: You see the role that you might fill, if I understand you correctly, Dr. Dolman, as being an advisory role in the most limited sense, that is advice based on the already accumulated experience and knowledge in these various disciplines?

Dr. Dolman: I think that is just the way we see it, yes, sir.

Senator Carter: On page 1, paragraph 2, Mr. Chairman, there is this statement made:

Canadian industries should offer more attractive employment inducements to PhD graduates in science and engineering.

Evidently the Royal Society or the person responsible for this thinks that can be done. I wonder if you could be a little more specific and tell us who you think should be doing a little more than is being done?

Dr. Dolman: Sir, I do not think one can answer that specifically. It seems to be a point of national psychology that we are content to get by with people of lesser qualifications. I see my colleague, Dr. Lortie, has something to say.

Dr. Lortie: I think I can speak to that issue because I follow as closely as possible what is going on in chemistry particularly, and I have read extensively the papers in Chemistry in Canada, which is the publication of the Chemical Institute of Canada. I think this is essentially the situation, that industry will employ mostly BSc's and sometimes MSc's because they are working on the honours level. When a PhD comes along there arise two aspects to the question, the first one being the specialization of the PhD himself who has been working mostly on pure science, and that is not adaptable completely to the kind of work that he would do in industry. There is a gap there between pure and applied science. That is what Dr. Gaudry was advocating in the paper referred to before. On this question of the PhD's, industry does not want to give them such responsibility because they are not prepared for it.

There are many fields in which the PhD could be employed just as well as in pure research, or in research which could be well done through his scientific training, so that he could be in any other department than research as such. He could be employed in

administration, for instance, with of course a certain period of training in that particular field. His training makes him available for different positions in industry. Industry at the present time at least does not do it as much as we chemists would like them to do it.

Senator Carter: Would you say some of the fault lies with the PhD himself, that because he is PhD...

Dr. Lortie: Yes, with the PhD, with his training and with industry.

Senator Carter: On the second page you say:

In their turn scientists throughout Canada should actively participate in discussions of current scientific questions, thereby helping to clarify obscure situations and to resolve contentious issues.

Why are they not doing that?

Dr. Lortie: Which one are you referring to?

Senator Carter: At the top of the second page.

Dr. Dolman: Sir, if I may intervene here, I think scientists are dedicated people. They are also sceptics by nature. They have to be in possession of evidence. For this reason they have often taken very little position in matters of public affairs, as likewise they have been rather backward in elaborating a philosophy. They have always seen the possibility of a negative side to what they hope might be positive. I think for this reason, quite apart from their intense interest in their work, which a good scientist sometimes finds occupies him night and day, they feel that to get involved in public affairs is a little tiresome and fruitless. I am not of this view myself, but I think a great number of one's colleagues are. I think that is one explanation for it.

Senator Carter: Are you saying that the type of training they are getting in the science courses as they go through is so narrow that it makes them sceptics?

Dr. Dolman: No, I should not quite say that the type of training makes them sceptical, but I would say it may sometimes be narrow, sufficiently so to make them less useful as citizens.

Senator Carter: Do you have any liaison with universities whereby you can discuss problems of courses and curricula where the

course may be lopsided, where there is not a proper balance? Everybody, I think, as we have learned, if he just takes purely courses in the physical sciences without a proper balance of the humanities and the social sciences, is bound to be a bit warped in his outlook.

Dr. Dolman: I entirely agree. I think this is precisely what our society stands for through its own fellowship. This is one of the great virtues of our annual meetings and, I hope, the more frequent regional meetings we may hold in future, that we do, by our very attendance and participation in them, express our belief in the whole man and in the various disciplines of life. There is nothing whatever to stop a scientist being a humanist. Many of us, I hope, are.

Senator Carter: My point was, can you bring any influence on the universities to have these sorts of things corrected insofar as courses are concerned?

Dr. Dolman: Insofar as of our fellowship perhaps a little more than half is employed in universities, they ought to be able to bring a great deal of influence to bear in this way.

The Chairman: I do not want to make a pitch for this committee, sir, but some people have told us also that the lack of a public forum or the lack of liaison with the parliamentarians perhaps explains also this lack of discussion, because people have the tendency of discussing among themselves at the level of the Royal Society, without any proper channel to present these conclusions or these recommendations to anybody precisely.

Dr. Dolman: Sir, the invitation to yourself to address us the other day was a good indicator of our desire to have the point of view that you represent conveyed to us. As a fellow yourself of our Society, I presume this indicates that we certainly give full consideration to scholarship and interest in public affairs from every aspect. And we do wish indeed to disabuse any impression there might be that we are an esoteric, mutually admiring group that has no intention to make contact with public affairs. If we can do this in any way without losing our dignity as a society and our essential purpose to exchange views on scholarship, we have only to be asked. Any suggestion made whereby we could indicate this desire to become more involved in public affairs would be most favourably received. I am quite sure of that.

Dr. Lortie: May I add something in answer to Senator Carter? There are different ways of looking at a situation, and Dr. Dolman has answered about the society itself. I would speak as a man who has been very close to the university in teaching chemistry. Again my example would be taken from chemistry. There have been many complaints on the part of industry, for instance, as to the chemistry departments in the universities in these last few years, that the course itself or the tuition has been so much oriented to research that there was a dearth of bachelors of science with a proper frame of mind to go into industry and into industrial laboratories.

That might be corrected by splitting probably the class into two categories, as they do in some places, the honours and the pass courses. But then even the pass course is so similar to the honours course that there is little difference between the two.

The other corrective is the more profound, as you mentioned, and that is more humanities in the science courses. I think that would be a great advance because we prepare specialists in our universities. They should be more broadly educated in their first year. For instance, a good course in economics and sociology could well be a good addition to the specialized courses leading to the degrees in biology or chemistry or something else. On the other hand, looking at the preparation in the social sciences for, let us say, sociology or anthropology, I would advocate better training in biology, psychology or political science, for instance.

I am on record in my presidential address as saying I would like to see these degrees in sociology and political science and history not so specialized at the undergraduate level, but rather that they should be left to the graduate level, so there would be a good basis of information and training. We should be giving a much broader basis of training and preparation at the undergraduate level, because we take them from the high school, where they have learned the rudiments and then they are confronted with a body of philosophy practically, or masses of information. But they just cannot grasp during the short years of an undergraduate course all of the training they should have in addition to their specialty. As it is they graduate as specialists only and there are certainly other things to be desired there.

Senator Carter: Do you see the pendulum swinging in the university a little bit from the social sciences and humanities to the

physical sciences and then a bit back? For instance, a thing like a war breaks out and there is tremendous emphasis on science and inventive technology, and then the war is over and we sort of coast along a bit and possibly we begin to realize that our main problems are social problems. It takes a little while to get back there. By that time something else has happened which puts emphasis again on the natural sciences.

Dr. Lortie: I know the Royal Society of London has recently held a conference on that. Young people are shying away from the science courses and there will be a dearth of scientists in the future if it is allowed to continue that way. The same thing is happening in the United States. And it is not only occurring just in science but in economics as well.

The Chairman: What about the field of biology, your general field, Dr. Dolman? Is there an increase in enrolment there as opposed to the physical sciences?

Dr. Dolman: I think that is probably correct, Mr. Chairman. Whether this is due to an inherent interest in life sciences which attracts women students, who of course are occupying a large part of our student enrolment these days and tend to prefer these sciences to the natural sciences, or whether it is that the physical sciences are getting so intricate that young people boggle at them is not quite clear. However, the trend is in that direction. The biological sciences have not suffered the same antipathy that is becoming quite evident in the student bodies against chemistry and physics.

The Chairman: What about your field, Dr. Clark, the position with regard to the physical sciences, the like sciences and the social sciences?

Dr. Clark: There has been a very marked shift to the social sciences. In my own discipline there has been a very marked shift to sociology which I explain in terms of hippies and Negro riots. We are being overwhelmed at the moment away from the humanities and into the social sciences. I cannot speak really in relation to the sciences.

The Chairman: There has been a very big increase in the enrolment in your own field.

Dr. Clark: It is catastrophic.

The Chairman: We are told it is catastrophic also in the province of Quebec.

Dr. Lortie: In the province of Quebec I think the rate of growth of the physical sciences is healthy, but the rate of growth of the social sciences is away above anything that we might have expected a few years ago.

Senator Robichaud: Is there not in the last few months a movement in the opposite direction? I know personally a large number of students who were in social studies and got disgusted with the situation and they are leaving and changing. This applies to Moncton and also right here at the University of Ottawa.

Dr. Lortie: That might happen to us too. There is a greater failure or mortality in the first year.

Senator Robichaud: After a year or two they are just leaving and going to other disciplines, for that very reason.

Senator Grosart: This would seem to raise a very important question as to whether or not a national science policy should follow these trends or assess them and decide whether a new national science policy should be used as a corrective.

Dr. Dolman: Indeed it does, senator.

Senator Grosart: Would you say this is something that national science policy, from the political point of view, should be concerned with? I say this because so many of our presentations are based on the current situation with a prescription that it is here to stay. To what extent should a national science policy follow or attempt to modify trends of the kinds that have just been raised by Senator Carter and Senator Robichaud?

Dr. Dolman: This is an exceedingly relevant point I think from the national standpoint. You will find a reference in our brief to the need to have a body that does appraise these trends and distribute the results as information. We have qualified that statement, however. It is important to recognize that university people are so dedicated to their own teaching fields that they naturally do their utmost to make this attractive to those students who feel they have a vocation in that particular field. As there will be a certain amount of obstruction to any directive that seeks to detract from their enrolment of what they feel to be useful potential scientists, I think we must concede that in the national interest some watch should be kept over these trends, because in the long run it

can only lead to surpluses of students who will be disillusioned and frustrated, and there will be a dearth in other directions where the nation needs qualified people. We have such gaps now, I believe. So I am very much in favour of a compromise here, whereby we have the information available and it is the duty of some organization to distribute it around to universities while taking due care not to attempt to issue directives.

The Chairman: Well, certainly directives would be completely undesirable in any case, but directives from here would be simply impossible. We are quite safeguarded from this danger at this level here.

Would you go so far as to say that this information should also be used by the granting institutions in developing their programs to encourage fellowships and that sort of thing?

Senator Grosart: Which is a directive.

The Chairman: It is not a directive.

Senator Grosart: It is a velvet glove.

The Chairman: It may be a corrective.

Dr. Dolman: Yes, it could be a corrective. I speak for myself here, but I would think within limits this is perfectly permissible. University professors, who form part of the body of these councils which consider distribution of funds, if they see the situation rightly, in their own interests and the nation's must eventually take cognizance of it and make the necessary correctives. In my view, to keep abreast of these trends, and to have the information distributed so that eventually

the public as well as the universities know it, is of prime importance.

The Chairman: Parents might like to know too.

Senator Grosart: One reason that prompted the question is that in a publication to which I subscribe, the Shakespeare News letter, it was seriously suggested that there be a five-year moratorium on books and these on Shakespeare.

Dr. Lortie: They likely put a moratorium on science many years ago in England.

Dr. Daniells: It is on Shakespeare's tomb, sir, "Good friend, for Jesus' sake, forbear".

Senator Grosart: To forbear to dig the bones, and not analyse them.

The Chairman: I think that this meeting unfortunately has to come to a close. I want to thank you, sir, and your colleagues for being with us this morning. As I have said to all those associations good enough to come to us now to present their views, I hope that it will be only the first and not the last meeting.

Dr. Dolman: Sir, I thank you for those words and to you and your colleagues I should like to say, on behalf of the Society, that it has been an unusually illuminating and encouraging experience for all of us to have had this chance for intelligent and searching interchange of information, and I hope it will have some fruitful results for the good of our nation. Thank you again.

The hearing adjourned.

APPENDIX 112

THE ROYAL SOCIETY OF CANADA
BRIEF TO THE SPECIAL SENATE COMMITTEE
ON SCIENCE POLICY

Special Committee

THE ROYAL SOCIETY OF CANADA

BRIEF TO THE SPECIAL SENATE COMMITTEE ON SCIENCE POLICY

CONCLUSIONS AND RECOMMENDATIONS

1. An adequate supply of highly trained scientists and engineers is essential to Canada's industrial progress and prosperity. A prime objective of national science policy should be to ensure that first-rate post-graduate training facilities and challenging employment opportunities are available for them within Canada. A suitable coordinating agency should regularly review the greatly increased numbers of graduate students undergoing university training in the various fields of science and engineering.
2. An uncertain proportion of these graduates can expect to obtain positions within the academic community; the majority must seek industrial employment, in their own country or elsewhere. Canadian industries should offer more attractive employment inducements to Ph. D. graduates in science and engineering, and take advantage now of the unprecedented opportunity to recruit competent staff of great potential accomplishment.
3. The nation's vast natural resources need systematic development and linkage to secondary industries. To achieve greater economic independence and indigenous control, Canadian industry must undergo substantial expansion of applied research and technological development. The necessary stimuli and incentives must not be provided, however, at the expense of increased support for basic research activities. Sound fundamental research projects require every possible encouragement in universities throughout the country, particularly where the available talent and other circumstances promise outstanding achievement.
4. The growth of a large, bureaucratic science policy apparatus within the government is undesirable. The Science Council of Canada is the soundest source of expert advice to the government on scientific issues, and should be closely concerned with decision-making processes in this field. Through its Chairman, the Council's views on matters of national science policy should be sought by and made known to the responsible Ministers.
5. The effectiveness of the Science Council might be improved if the Chairmanship were a full-time appointment, tenable for a period of at least five or six years. However, if these conditions proved incompatible with procuring the services of the best available appointee, other means should be devised to secure the Council's intimate involvement in the development of sound policies.
6. The present membership of the Science Council lacks representation from certain important fields of applied science having close relationships with the social sciences, e.g. public health, food technology, and communication. The Council,

individually and collectively, and its Chairman especially, should maintain effective contact with the Canadian scientific community. In their turn, scientists throughout Canada should actively participate in discussions of current scientific questions, thereby helping to clarify obscure situations and to resolve contentious issues.

7. As industrialization and technological exploitation of the country's resources proceed, counter-currents of disillusionment and distrust of materialism seem inevitable - indeed are already in evidence. In the ensuing reexamination and reaffirmation of values, the humanities and social sciences must play a vital role. These fields need financial assistance, especially in the form of research grants tenable at Canadian universities, comparable to those awarded in the natural sciences by the National Research Council, which provide for graduate students, post-graduate fellows, research assistants, and incidental expenses, including travel.
8. Canadian humanists and social scientists, particularly in French Canada, are grievously handicapped by inadequate library resources. A recent estimate indicated that the holdings of university libraries throughout Canada should be roughly doubled if full programs of research were to be undertaken in these fields. A serious deterrent to the advanced scholar is the dearth of major specialized collections. Development grants to enable universities to rectify these deficiencies, would benefit incalculably the whole country.
9. The principle of direct federal government support of higher education can be as readily justified for researches designed to foster a national cultural ethos, as for researches whose main objective is industrial prosperity. Such support does not always involve financial outlays. For example, scholars in the humanities and social sciences would greatly welcome modification of the "fifty-year rule" governing their access to the records of the federal government. This waiting period should be reduced forthwith to not more than thirty years.
10. No radical changes are advocated in the organization of the many national institutions concerned with research in the humanities and social sciences. The Canada Council in particular should continue in its present form, though with ampler and more flexible funds at its disposal. However, there is need for clarification of aims and coordination of activities of these bodies, especially in connection with the Learned Societies, which urgently require the establishment of a central secretariat in Ottawa. In this enterprise (not necessarily elaborate) The Royal Society of Canada has already demonstrated, and takes the opportunity to reiterate, its desire to play a leading part.

Special Committee

THE ROYAL SOCIETY OF CANADA
BRIEF TO THE SPECIAL SENATE COMMITTEE ON SCIENCE POLICY

INTRODUCTION

Historical Background

The Royal Society of Canada was founded in 1882 by a group of Canadian scholars, who had met in Montreal to write its constitution at the suggestion of the then Governor-General of Canada, the Marquis of Lorne (afterwards Duke of Argyll). As defined in its charter (46 Vic. Cap. 46, 1883), "The objects of the Society shall be to promote in every practicable way, the Arts, Literature and Science, for the best interests of Canada. To further these objects, the Society shall be in the nature of an Academy organized for the purpose of bringing together distinguished men from many branches of learning". Whereas the few literary, historical and scientific societies then in existence recruited their membership from the ranks of local amateurs, the founding fathers and the charter members of the Society were, in the words of its first president, Sir William Dawson, "...selected and representative men who have themselves done original work of at least Canadian celebrity". The Society remains true to the explicit intent of its founder, "...exclusive in its membership but inclusive in that it offers its benefits to all".

Scope of the Society's Activities

The Royal Society of Canada fulfils its functions as a national academy by recognizing high distinction and stimulating achievement in the humanities, the social sciences and the natural sciences, by election to its limited fellowship, by awarding medals and prizes, by financial assistance to scholars, and through its publications. The Society comprises three sections, of which Section III, with a membership of about 465 Fellows representing the Natural Sciences, is patterned on the Royal Society of London. Section I (Section des lettres et des sciences humaines) and Section II (Humanities and Social Sciences Section), number about 80 and 140 Fellows respectively.

The Royal Society of Canada is unique in seeking to elect to its fellowship the most eminent Canadian representatives of the main branches of human knowledge; and also in regularly bringing together, for active participation in its programmes and committees, a diversity of French- and

English-speaking scientists and scholars. It is acknowledged to be this country's senior learned society. The proceedings at its annual meetings have always exemplified and symbolized the interdependence of the different forms and aspects of human knowledge and learning, as well as the bilingual and bicultural character of our country. In recent years, increasing importance has been attached to interdisciplinary communication.

Since this Society's foundation nearly ninety years ago, the numbers of Canadian scientists and humanistic scholars have greatly increased, the social sciences have evolved, and various "learned societies" have become established. Most of these learned societies owe their existence to the initiative of small groups of fellows of The Royal Society of Canada, who were the nuclei around which gathered their colleagues in the universities, the government service and the professions. These societies have played and still play a vital part in the progress of research and learning in their particular fields of interest. However, the Royal Society's multidisciplinary composition and its non-political character should permit it to provide broad, objective and authoritative consideration of scientific and humanistic problems to an extent unequalled by any other learned or professional Canadian society. A few months ago, the Society was gratified to be requested by representatives of more than sixty learned societies to exercise leadership in areas of common concern, e.g. by co-ordinating the places and dates of their annual meetings, and by issuing a directory of all the national learned societies.

Again, The Royal Society of Canada can claim to have been largely instrumental, either collectively or through the initiative of several of its fellows, in securing the establishment of the National Research Council, the Astrophysical Observatory, the National Library, the National Archives, the National Gallery, and many other institutions, where its fellows occupy key positions. Such initiatives are in keeping with the Society's policy of proposing new ventures or recommending timely improvements that affect many fields of learning in Canada.

NATIONAL SCIENCE POLICY

The Royal Society of Canada is profoundly interested in the formulation and implementation of a national science policy that is challenging, imaginative, and geared to the resources of the country and the capabilities of its people; and it has repeatedly expressed the conviction that Canada must develop such a policy. For example, in June 1964, at the annual meeting

held in Charlottetown, P.E.I., it arranged a symposium on the "Organization and Support of Basic Scientific Research in Canada", in the course of which the Honourable C.M. Drury, then Minister of Industry, who participated as guest speaker, invited the Society's advice on these matters. Accordingly, in February 1965, a delegation from the Society presented a brief to the Minister, entitled Towards a National Science Policy. The brief was published soon afterwards, along with other papers given at the Charlottetown symposium, as a preprint of the Transactions of The Royal Society of Canada. Copies of this document were distributed to all members of the Senate and House of Commons.

The Government's subsequently announced intention of creating a national Science Council as an advisory body was strongly supported at the Society's annual meeting at Vancouver in June 1965. Letters of endorsement from the Society, conveying its desire to co-operate fully in the prompt implementation of this venture, were sent to the Prime Minister and the Minister of Industry. In February 1966, another delegation met with the Honourable Mr. Drury, in order to stress the urgent need to establish this Science Council and to offer the Society's assistance in the selection of suitable members. In response to the Minister's assurances that he would welcome the Society's representations, an ad hoc committee was set up, which after due consideration submitted an annotated list of nominees.

Two points call for comment here. First, no section of The Royal Society of Canada may constitutionally take formal action on a public issue without the knowledge and approval of the Council or its Executive Committee. Hence, though the Natural Sciences section (Section III) initiated the above-mentioned approaches to the Government, and also prepared a statement on national science policy, both delegations to the Minister were headed by the President of the Society - who, on the second occasion, happened to be a non-scientist. Thus it was demonstrated again that when confronted by issues of national importance, the Society readily generates sufficient unity of purpose and mutual confidence to take concerted action.

Secondly, when these representations were being made by the Society to the Government, the word science as used in the terms "national science policy" and "Science Council of Canada", was generally understood to mean the natural sciences, as it does in popular parlance. The possibility was not seriously considered that in this context science covered systematized knowledge in any field of economics or sociology. The Society's committee

therefore prepared and submitted its list of candidates for membership in the Science Council of Canada on the assumption that the commoner usage applied; and the validity of this assumption seemed to be confirmed when the Government announced the actual membership. No humanist or social scientist was appointed originally to the Science Council - just as no natural scientist had been appointed to the Canada Council, or to the Humanities or Social Science Research Councils. The soundness of this policy may be arguable, but at least it seemed consistent.

Usage of the word "Science".

The natural scientist claims no monopoly of the word science, which of course has other applications, based on a more broadly interpreted derivation from "scientia". However, we feel obliged to draw attention here to the unfortunate confusion and needless misunderstanding that might arise among the general public, as well as in Government circles, and perhaps even in the minds of some members of the Science Council, if the word science were to become employed indiscriminately in these two distinct senses.

Few if any members of this Society would dispute that the natural scientist differs profoundly from the social scientist in his techniques, attitudes and purposes. These inherent differences may be narrowed, and through goodwill and insight can be bridged; but they are not eliminated by being brushed aside as inconsequential. The natural sciences may be defined (at the risk of over-simplification) as dedicated to the intensive study of man's physical and biological environment - from the most distant star to the minutest virus. Human life has been facilitated, enriched, prolonged, and in many respects greatly changed, through applying the knowledge thus gained of environmental mechanisms and control. In contrast, the social sciences are devoted primarily to analyzing the individual and group behaviour of man himself. The resulting increased understanding, linked to compassion, have improved the performance, buttressed the security, and alleviated many of the hardships and injustices of modern society.

However dissimilar these endeavours may be in approach and immediate objective, their ultimate beneficiary is mankind. The happiness, prosperity and general welfare of the nation hinge upon both kinds of activities receiving fair and sagacious encouragement. Inevitably, they are vigorous competitors for substantially increased support from the limited public funds available. Their respective claims for consideration

should be judged on their own distinctive merits, and must not be confused or distorted through erroneous notions of their kinship in "science".

Importance of the Humanities

In the shadows of such powerful contenders for support, the needs of those older fields of learning and scholarship known as the humanities tend to be overlooked. The claims of the humanists for financial aid for their own research projects have not gone unheeded during the past decade, but they remain comparatively under-privileged in that respect, as a later section of this brief eloquently persuades. By the constitution of the Royal Society of Canada, the humanists share membership with the social scientists in Sections I and II. Hence the two groups have jointly stated their case for more generous allocations. Since the viewpoints and desiderata expressed independently by Sections I and II indicated that Francophone and Anglophone confrères in these fields had common aspirations and grievances, a combined submission has been prepared, which may be taken to represent a plea from humanists and social scientists throughout Canada for expanded research opportunities and facilities. Their colleagues in the Natural Sciences section are in accord with these claims.

Science (in sensu populi) cannot flourish in a cultural desert. The fallacy dies hard that the humanist and the scientist necessarily stand far apart in temperament, articulateness or mutual sympathy; such insularity can only warp the former's understanding and impoverish the latter's inspiration. As Anatole France put it: "Science separated from letters is mechanical and brutish, while letters divorced from science are shallow and without substance". Indeed, this Society's own healthy survival despite its heterogeneity is no mere anachronism, but a testimony to each member's awareness of the many-sidedness of reality and the complementarity of knowledge. To quote one of our own fellows, Desmond Pacey, writing of the humanities: "We are all human beings, and presumably believe, as Milton put it in Areopagitica, that Truth is ultimately one and that we are all under an obligation to piece together its fragments. The humanities do not oppose, but complement, the search for truth conducted, by somewhat different methods but with the same fundamental aims, by the natural and social scientists".

The Natural Sciences

Without prejudicing the valid claims of the humanists and social scientists for increased support, Section III's presentation, which immediately follows this preamble, likewise stresses that the national interest requires increased appropriations for expanded research, both fundamental and developmental, in the natural sciences. In this large section, with its wide range of subject-divisions, occasional divergences of opinion are bound to arise. For example, a well-worn topic of debate, the relative importance of basic and applied research, has recently come to the fore again, slightly disguised under the terms "curiosity-motivated" and "mission-orientated" research. The Section's observations and conclusions on this issue represent a constructive compromise. There is general agreement that applied research and development procedures, so vital to the industrial prosperity of the nation, cannot flourish without generously supported fundamental research activities, which continually replenish the reservoir of novel ideas and fresh insights that is the source of sound inventiveness and bold technology.

THE SOCIETY AS AN ADVISORY BODY

One of the most arduous responsibilities of the Government of Canada and its advisory agencies is the shrewd, dispassionate apportioning of public funds to support research in the natural and social sciences, as well as in the humanities. Successful handling of such complex, recurrent problems demands the combined qualities of Janus, Solomon, and Job. The Royal Society of Canada does not presume to credit its membership with spectacular endowments of those attributes. However, for the reasons already indicated, which will be further emphasized and illustrated in subsequent parts of this brief, it is respectfully submitted that situations arise periodically in which this Society might prove singularly fitted to advise and assist the Government. All sections of The Royal Society of Canada sincerely assure the Honourable Members of the Senate that in such circumstances any invitation to make the services of their fellows freely available to the Government of Canada will receive a prompt and ready response.

SCIENCE POLICY AND THE NATURAL SCIENCES

Explanatory Comments

For organizational convenience and in order to match the common interest of members, the Natural Sciences Section (Section III) of The Royal Society of Canada is divided into eight subject-divisions. These include mathematics as well as the major disciplines in the physical and biological sciences - physics, chemistry, geology, plant and animal biology, microbiology and biochemistry. Representatives of the medical and engineering fields are to be found in more than one division, depending on the specialized interests of the individuals concerned. In addition, there is an interdisciplinary division for fellows representing astronomy, meteorology, geophysics, and certain other branches of natural science. The Section can therefore claim to embody a source of expert knowledge and authoritative opinion on practically the whole range of the natural sciences.

The membership of Section III comprises, in roughly equal measure, fellows who hold academic appointments at universities throughout Canada, and fellows with senior positions in various government science services and establishments, e.g. the National Research Council, and the Department of Agriculture, Fisheries, and Energy, Mines and Resources. The membership composition thus ensures that both the fundamental and the developmental aspects of research have their supporters and will be sympathetically appraised. These two types of research are the subject of continuing debate, and our earnest aim and concern is to view them in conciliatory perspective.

As indicated in the preamble, it was the Natural Sciences Section of The Royal Society of Canada which instigated the Society's approaches to the Government in recent years on questions relating to national science policy. In its brief Towards a National Science Policy, presented to the Government and published early in 1965, the need for greatly increased grants for both basic and applied research was stressed, and the order of increase considered appropriate (by comparison with the performance of other countries) was estimated. While some gratifying improvements in subsequent annual levels of support are acknowledged, there have been very disquieting trends in the opposite direction recently. We do not propose to add further fiscal data to the mounting pile of surveys of needs and resources, and of cost-analyses respecting scientific research and development in all its facets, which are already available to this Special Committee of the Senate - particularly

since more such findings are still in course of collection and tabulation by experts. Our main purpose is rather to express firm views on relevant current issues in which the Section's consensus is clear; to assist in the development of compromises which occasionally might provide constructive alternatives to extreme and otherwise irreconcilable positions; and to offer the advisory services of the Natural Sciences Section on any matters affecting national science policy which lie within the broad competence of The Royal Society of Canada.

THE NATURAL SCIENCES AND NATIONAL DEVELOPMENT

Scientific investigation in the various fields of biology, geology, chemistry, physics, mathematics, and astronomy, has provided the impetus and foundation for much of the advanced technology which so pervasively and inevitably features today's world. Indeed, the extent to which technological developments affect the life of any country is now mainly determined by the amount and proportion of the national expenditures devoted to them.

The future status of Canada as a nation will depend to an important degree on the ability of our scientists to establish a leading position in world science in areas of major importance to Canada, and also on their capacity to recognize and adapt to this country's benefit the vast array of research findings being made by scientists elsewhere. Although Canadian scientists and engineers cannot be expected to excel in all fields, they must be among the best in areas of critical concern to this country.

Our country's rich endowment of natural resources ought to be used to far better advantage. Many of these resources, instead of merely serving as a medium of economic exchange until they are irretrievably depleted, could be linked to secondary industries within Canada, thus multiplying their value many-fold, while providing increased employment opportunities and more stability to our primary resource industries. These commonplace observations are subject to a qualification that we wish to stress: optimal resource development is contingent upon the effective application of our scientific and engineering manpower, and the establishment of a secure and progressive national science policy that provides for an energetic research program.

Attempts are frequently made to separate such activity into three components; basic research, applied research, and technological development. We do not subscribe to any rigid classification, but wish to stress that the process is a continuum of research effort, each part being essential to the whole. No aspect of this process can be de-emphasized, or performed at less than maximum efficiency without reducing the total effectiveness.

On the other hand, deficiencies in the final stages of some technological development should not be blamed upon the basic research that may have initiated the process, on the grounds that there is "nothing to show" for the time and money expended. The nurturing of novel scientific ideas, and the learning and trial of new techniques, have inherent values that must never be confused with or made dependent upon, an immediate flow of saleable products.

In this period of financial stringency, it would seem timely to reaffirm the tenets of the traditional academic attitude towards fundamental research in the natural sciences:- i. The pursuit of scientific knowledge for its own sake is a valuable and intensely important exercise of the rational, civilized mind. To quote from our earlier submission, Towards a National Science Policy, it is "a vital intellectual activity, in many respects transcending the material benefits that may result from it". ii. Neither excellence nor even high competence in such specialized intellectual activities, with their concomitant technical skills, can be acquired and maintained without inspired teaching and first-rate, post-graduate training opportunities. iii. The encouragement of basic research in any field of natural science tends to stretch the bounds of knowledge and to provoke fresh insights. The history of science reveals clearly that the resulting stimuli give rise to new techniques and processes, which in turn may yield immense and various benefits, ranging from the more efficient harvesting or harnessing of our country's untold resources to the promotion of health and the prolongation of life for all mankind.

NATIONAL EXPENDITURES ON RESEARCH

Some previous representations to this Special Committee of the Senate have pointed out that Canada stands well behind several other countries of the world in the proportion of its financial resources spent on research and development. While we recognize and deplore this fact, we believe that a more important consideration is the gross inadequacy of government support for research in problems of special importance to our country, notably transportation, communication, water resources, northern development, human ecology, computer science, the conservational aspects of the development of our primary industries, and our potential as a food producer for other countries of the world.

The present pattern of governmental commitments to support of research in Canada shows a distribution of funds different from that in many countries,

a greater proportion being devoted to in-house government research, and a relatively small proportion to industrial research. The reason for emphasis on the former is largely historical, and results from a predominantly centralized development of research in a young, thinly populated, and geographically extended country. The serious deficiency in industrial research and technology is related largely to our proximity to the United States, where the parent companies of many Canadian subsidiaries are conducting research partly or wholly supported by agencies of the United States government. This situation might appear to provide a cheap source of research findings, but it should be recognized that such research is primarily directed towards solving the problems of American companies and programs, and that any benefits accruing to their Canadian subsidiaries are secondary and often incidental.

If the Canadian economy is to benefit substantially from advances in industrial research and technology, a marked stimulus must be given to their development within this country. This can only be accomplished by much larger and less rigidly controlled financial incentives to industry, through such devices as more liberal tax concessions, increased research grants, and greater contracting-out of research and development programs by government agencies and departments. As much as possible of the fundamental phase of any such expanded program should be conducted at universities; but of course this type of academic participation in Canadian industrial research and development must not be stultified by paltry financial support. We would stress the critical necessity of subsidizing opportunities for virile basic research projects of broadening scope at the universities, particularly since graduate enrollments in science departments are still rising. Special financial encouragement should be available for undertakings that show outstanding promise or accomplishment.

Some scientists and government officials believe that more mission-orientated research grants might advantageously supplement the traditionally fundamental character of academic research. In fact, certain national departments of science have recently entered the field as research-grant agencies. Upholders of the traditional university standpoint on the special importance of basic research tend to view this move with mixed feelings. They are by no means intransigently opposed to mission-orientated research, for some of their colleagues may have received support of this type for years. Their position is rather one of anxiety that government research funds should not become increasingly diverted

into the "practical" type of "rapid-return" project, with corresponding neglect and disparagement of "curiosity-motivated" research. The national consequences of such a policy could be disastrous: for nothing would more surely accelerate the brain-drain of talented professors and graduate students — who should be reckoned among the country's most significant vital resources.

OUTPUT OF TRAINED GRADUATES AND THE RESEARCH OPPORTUNITIES IN CANADA

Although the paramount role of universities in post-graduate training in the natural sciences is undisputed, there are sound reasons why some national co-ordinating agency should keep under annual review the total registration and disciplinary distribution of graduate students in M.Sc. and Ph.D. programs throughout Canada, in relation to the numbers for which there appear to be a prospective employment demand. Indeed, information of this sort has been collected in recent years by the National Research Council, and cannot fail to be useful to supervisors of graduate research programs as well as to graduate students themselves. Any agency collecting such information should not release it unguardedly, lest it be misinterpreted; and it should also bear in mind that scientists in the academic world are particularly sensitive to any suggestion of outside regulation or interference involving their research and teaching programs.

The usefulness of the foregoing data would be multiplied if the agency could uncover explanations for the relatively heavy demands of Canadian industry for graduates at the Honours B.Sc. and M.Sc. levels, in contrast to the rather meagre opportunities for Ph.D. graduates. A certain proportion of graduates in this higher category can expect to secure employment requiring training and aptitudes for basic research, but a much larger proportion should be involved in fields of applied research and development that more directly promote increased economic returns to the country.

The natural sciences have made considerable progress in Canada despite a deficiency of qualified scientists and engineers during most of the post-war period. This situation appears at present to be improving rapidly, but much of the national benefit will be lost unless greater and more challenging opportunities are provided for the employment of our highly trained graduates. To this end it is essential that Canadian productivity should be stimulated by greatly increased industrial research and development expenditures. Such an investment could create attractive employment possibilities for graduating scientists and engineers, who otherwise would enter non-research fields or leave Canada. Our broad scientific development, like our economic progress,

has been strongly influenced by that of the United States. This influence will continue to increase unless we take the fullest possible advantage of the present Canadian supply of trained scientists and engineers, to stimulate independently the productivity of our national economy and culture.

NATIONAL POLICY ON RESEARCH IN THE NATURAL SCIENCES

As stated in the introduction to this brief, Canada must have a national science policy "that is challenging, imaginative, and geared to the resources of the country and the capabilities of its people". In developing the details of such a policy, we believe that the present Science Council of Canada most nearly conforms to the type of body needed to give expert advice to government. For the Council to be effective, its members must be broadly representative of Canadian science and technology. They should be persons who have acquired their reputation through scientific achievement, and who also have broad vision and mature judgment. The desirability of appointing some working scientists and engineers to membership on the Science Council was reflected in the Society's original recommendations to the Minister of Industry, and we reaffirm our conviction on this question.

Guidance from the Science Council cannot be effectively secured and communicated by a part-time Chairman located in a different city and continuing to carry, at the same time, other professional responsibilities. The recent appointment of an Executive Director and the transfer of personnel from the Science Secretariat to form a staff group for the use of the Science Council may have simplified the mechanics of operation, but in our opinion it has not basically improved the problem of senior level communication. We consider it essential that the Chairman should remain the Council's spokesman, with the support of its membership and indirectly of the whole scientific community. We recognize the need for highly competent, confidential, and readily accessible advice, and we believe the Chairman of the Science Council, with the assistance (when required) of special sub-committees appointed by the Council, is its best source. The present arrangement unfortunately encourages the government to resort to advice close at hand, e.g. from an in-house committee whose scientific base may be much too narrow. We urge emphatically that steps be taken to close this communication gap between the Science Council and the government. One way to achieve this might be to establish the Chairman's position on a full-time basis, for a term of at least 5 or 6 years. But if such conditions were incompatible with procuring the services of an

individual widely recognized as outstandingly qualified for the position, some other mechanism should be devised for ensuring his more intimate involvement in the formulation of government science policy.

Whilst fostering these indispensable consultative relationships with the Government, the Chairman of the Science Council must be on guard against the risk of becoming isolated from the scientific community across the country. Various means of avoiding this contingency suggest themselves. For instance, the Chairman and Vice-Chairman, and selected representatives of the Science Council, should not be too preoccupied or desk-bound to make periodic visits to the main centres of research across the country. Familiarity with scientific situations and opinions in several areas of Canada should be reckoned an important qualification for potential appointees to that Council. Again, appropriate two-way channels of communication should be arranged and kept open between the Chairman of the Council and responsible representatives of different sections of the Canadian scientific community.

For its part, the Government should appreciate that the processes of arriving at decisions involving national science policy ought to be in themselves acceptable and reassuring to the scientists affected by those decisions. In particular, if questions of priority arising at a time of financial stringency make it necessary to defer some projects indefinitely, all concerned should feel confident that such decisions have been preceded by thorough consultations with the Chairman of the Science Council of Canada, as well as with experts in the appropriate fields of science.

We fully realize that decisions on national science policy must take into account the country's financial situation, and that the funds available for the development of Canadian science are limited. Nevertheless, we reiterate that if modern scientific and engineering advances are not applied effectively and continually to the betterment of all phases of Canadian life, our standard of living relative to other leading nations will inevitably begin to decline. Besides, the extremely complex economic and social problems of Canada require a multi-disciplinary approach, and science often can contribute to their solution. In this context, we would emphasize the critical importance of research planning and resource assessment, which cost relatively little in relation to the total expenditures on research and development.

Finally, our views on a national policy for scientific research may be summarized in the following general terms. Sound research projects in any field deserve encouragement provided well-qualified personnel are available to carry them out. Special attention and support should be given to the

development of so-called "peaks of excellence" in any sector of Canada's research and development program, whether under university, government, or industrial auspices, or as a joint project. In addition, Canada particularly needs scientists with special competence in certain critically important fields. The logical body to identify and facilitate development of these aspects of our scientific effort is the Science Council. In some countries, e.g. the United Kingdom, a government Department of Science has performed this kind of role. We do not favour the formation of such a department, but believe a more independent body such as the present Science Council would serve the purpose better, provided an effective procedure can be devised for translating its recommendations into national policy.

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RESEARCH IN THE HUMANITIES AND SOCIAL SCIENCES IN CANADA

Prefactory Comments

Research, a word that once signified only a close and careful inquiry after some specific thing or person, has now shifted its meaning to signify the activity leading to publication of newly discovered knowledge. In the context of this appeal for support, the word research will include not only the narrow concept of a systematic inquiry in order to discover facts or principles, but also that qualitative attainment of learning known as scholarship and those acts of judgment, involving subjective elements, known as criticism.

To the Italian humanists of the Renaissance, who shaped the notion from which our concepts of the humanities and social sciences have come, the studia humanitatis encompassed a circle of classical studies, of rhetoric, of poetry and history, in conjunction with moral philosophy. In time, there were added other studies - natural philosophy, theology, law, medicine, mathematics. Lord Bacon narrowed the term so as to exclude natural philosophy or, as we should say, "Science". A somewhat different classification of knowledge was offered in Diderot and d'Alembert's Encyclopedia, which recognized three categories - the sciences of God, of Man, and of Nature. Within the present century, certain studies of humanity, such as economics and sociology, have grouped themselves under the signation "social sciences" or sciences humaines. Theology, medicine and law have developed into separate faculties. These differentiations are convenient; no one would wish to abolish them.

An objective measure of the health and growth of research in the humanities and social sciences in Canada may be found in a comparison between the 1947 report entitled The Humanities in Canada, and its successor of the same title, issued in 1964 (with Supplement in 1966), all published by the Humanities Research Council of Canada. We move from an atmosphere of gloom and stoical resolution of the 1940's to one of buoyancy and expectation of the 1960's. Whereas the bibliography of scholarly publications from the dawn of Canadian history to the year 1947 filled 42 printed pages, the list expands to 339 printed pages for the two decades from 1947 to 1966. This marks a break-through of real cultural significance. Increases in the number of doctoral candidates in our universities, in the range of subjects studied and of course offered, in the holdings of university libraries, and in the amount of financial assistance for research, are equally striking.

The conclusion to be drawn is that, in proportion as humanists and social scientists in this country have been allowed time, money and facilities for research and publication, they have risen to the challenge. If a single index of change were to be selected as decisive proof of our upsurge in research, one could point to the growth of university press publications. According to Press Notes, "During the calendar year 1966, the University of Toronto Press published 98 new books, a number exceeded, among university presses, only by California, Chicago, Harvard, Yale, and Princeton, in that order". Laval, Montreal and McGill have now entered the field of university press publication; British Columbia, among other institutions, is expected to follow.

The two processes of the production and the critical reception of research, have interacted. A few years ago, Canadian humanists and social scientists were generally obliged to wait for an intelligent response to their work from outside the country; e.g., in the case of Fairley's work on Goethe, Lachance's philosophical works, or Innis' researches on the fur trade. Since the formation of the Canada Council, however, there has been a great and progressive change, in that Canadian research in the humanities and social sciences has now a group of appreciative, perceptive critics within our own borders. No one who has been associated with the Humanities or Social Science Research Council of Canada, or with the Canada Council's system of fellowships and grants, can fail to have noticed the change of intellectual climate in Canada since 1957. All this, however, in view of present needs, should be regarded as no more than a good beginning.

SIGNIFICANCE AND VALUE OF RESEARCH IN THESE FIELDS

In two critical regions of our national experience - the area of incompletely resolved tension between French and English cultures and societies, and the area of uncertainty surrounding science and technology - both the humanities and the social sciences have essential roles to play.

In the effort to foster mutual regard between French and English cultures, the humanities offer many unifying opportunities. It is a common experience for both French- and English-speaking Canadians who travel abroad as students or tourists to realize that, whatever rifts may separate them at home, these are as nothing beside the gulfs that separate them from Europe,

Asia and Africa. We have, in other words, a common culture in this country that needs only to be discovered and acknowledged. The question of languages is a primary one: intolerance is replaced by sympathetic understanding in proportion as we enter the language and literature of our complementary culture. The means of unity, like the causes of division, lie very largely within the region of the humanities. Philip Stratford rightly states, "... it is an indisputable fact that a lot more translation would be a great boon to the country. Translation is a bridge between people, and we in Canada desperately need more and better bridges of this kind. In a very real sense, the life and future of our country depends on our communications systems." The mass media, which have such powers for good or evil, are in their transmission inseparable from a commitment to language. One looks forward to the day, and hopes to hasten its coming, when students will read, not histories of French Canada or stories of the expansion of the Dominion into English-speaking provinces, but a History of Canada, intelligible to, acceptable to and serviceable to all Canadians. This will not come about by a sudden decision but as the coordination of many studies, of which some already exist.

Similarly, we must hope with confidence for a history of Canadian literature presented as one continuum. Readers for such a history are the generation of students now discovering that the poetry of Irving Layton or the prose of Gabrielle Roy speaks equally for French and English. Much remains to be done before a common history and common criticism are possible - before the recognition, acceptance and development of strong lines of common culture become natural to everyone.

The contribution of the social sciences to an understanding and resolution of the problem of French-English relations in Canada is no less significant, as the research studies done for the Royal Commission on Bilingualism and Biculturalism attest. A social scientist is now Prime Minister of Canada, and the strength of his understanding of the problems of Canadian unity develops from heavy reliance upon the findings of research in the social sciences. Resolution of the social

conflict between Francophone and Anglophone Canadians is largely dependent on the work of economists, political scientists and sociologists.

The second area of uncertainty, that surrounding the growth of science and technology, is equally in need of the approach of the humanist and social scientist. Not that scientists are inhumane or antisocial, in any sense of the words, but rather that judgments governing policy-formation in the area of science and technology are ultimately related to human conduct and social life. The humanities and social sciences cannot pretend to produce glib and ready answers to such problems, but it is within those disciplines that answers must be sought. The present widespread unrest among university students in Canada, as in other parts of the world, arises largely out of disillusionment and questioning of the materialistic values associated with the growth of science and technology. If the values of our western society are to find a firmer basis, it should be sought in the humanities and social sciences.

Humanistic and social science studies in this country have shown admirable concern for the clarity of Canadian self-knowledge and the quality of Canadian life. Canada has been defined as "a concept nurtured in the minds of a small minority of Canadian leaders, aided and abetted by a few historians". The literary humanists, the historians, the economists, political scientists, and other sociologists, have never lost the thread whose strands are a concern for political freedom, a feeling for the tradition of Judeo-Christian doctrine, an appreciation of the ancient world of Greece and Rome, and a preoccupation with ethical and social values. What they have begun must be continued, in ways adapted to present discontents and current problems.

The Unpredictability of these Studies

Any estimate or prediction respecting the humanities and the social sciences must allow for the elements of uncertainty, surprise and unexpected superabundance that all activity of the imagination brings in its train.

Few Canadians can think long about research without considering how it will benefit Canada as a whole. As Hans Selye has already said to this Committee, "One does not easily attack a nation which is useful to everyone". He applies his aphorism, quite rightly, to medicine. The classical example is Plutarch's statement that Athens was saved from demolition in 404 B.C. because its Lacedaemonian captors were reminded that it had been the home of the poet Euripides. If we ourselves pursue humane studies wholeheartedly, we may some day have a Shakespear as well as a Shakespeare festival. In affirming our faith in the humanities and the social sciences as indispensable to the building of a stable society, a viable culture and a national ethos, we must take time to recognize a paradox. A recent paper by Stuart Hampshire says summarily, "Imaginative energy has largely incalculable sources and serves largely unconscious needs". He supports his contention by evidence in the history of research and criticism, from Descartes to Sartre. It follows that no one can estimate or even identify all the benefits to Canada flowing from the life-work of Harold Innis and Léon Gérin, or the work of Northrop Frye and Jean-Charles Falardeau still in progress. The imaginative spirit bursts the bounds of the formal disciplines. Many examples could be cited of historians, political scientists, editors and publishers, producing books that clarify the image of Canada by profound insights, which could not have been foreseen when they began their various investigations. Some such illustration and defence of the unpredictable element in research needs to be made if committees allocating funds are to give equal attention to all kinds of potential achievement.

Research and School-teaching

Although this brief is not formally concerned with primary or secondary education, the role of humanistic and social science research in the improvement of school-teaching deserves notice. Children report that many teachers have a superficial or unenthusiastic acquaintance with their subject. This deficiency no amount of deployment of equipment and method can remedy. For such people, who may be academically deficient, but often have a strong professional interest, a grant in aid of research, with leave of absence, can prove revitalizing and the

turning point of a whole career.

About the larger issue of the dependence of teaching upon research, there should be no need to argue. The day is long past when tradition determined the content of instruction and teaching methods came naturally to instructors of character and good will. The pace of change is such that content of course, methods of analysis, and vocabulary of exposition, are in states of continuous obsolescence. Only by a series of fresh approaches to curriculum, on the part of teachers and those who teach teachers - approaches that involve personal research in depth into at least limited areas of their fields - can Canadian education keep up to standards demanded in the larger world.

AREAS OF CRISIS

The Staffing of Universities, Colleges and Federal Agencies

The staffing of departments in the humanities and social sciences in Canadian universities is now a cause for grave concern and will become even more critical as enrolments mount. In 1967-68 it is estimated that about 268,000 full-time students attended our institutions of higher learning. Studies by the Economic Council of Canada indicate a probable enrolment of 540,000 full-time and 150,000 part-time students by the year 1975.

In a subject such as English, by 1975 the present staff of about 1,200 probably must be doubled. In some of the social science disciplines the required staff expansion may be even greater. The alternatives are a doubling of the present staff's teaching load; an equivalent dilution of the staff with untrained people; or massive use of audio-visual mechanisms, whose capital and operating costs are hardly less alarming and whose results are uncertain.

The relevance of such figures to research in Canada should be apparent. University departments in the humanities and social sciences have had to depend heavily upon recruiting persons trained outside the country. In some of the more rapidly growing disciplines, such as political science and sociology, a number of Canadian universities have built up staffs almost wholly non-Canadian. The contribution of non-Canadians to this country's scholarly life has been in many instances very great. However, if certain trends continue, an increasingly high proportion of American scholars, most of them well qualified and some of considerable distinction, but having significant differences in orientation, ideology and fundamental loyalty, could before long move into control of Canadian curricula and teaching methods. Such a prospect is indeed disquieting. In the perspective of the past half-century, it is evident that the humanities and social sciences prospered and grew strong in this country in the years between the two world wars because our universities strengthened their staffs

with Canadians, who were concerned about the problems of Canadian life. Our universities met successfully the problems of expansion following World War I, but were unprepared to meet the more acute problems of the past ten or twenty years.

Graduate Studies

If the need for trained people in the humanities and social sciences is to be met, Canadian graduate departments must be considerably strengthened. The graduate student, who has long been an accepted part of the academic scene, must now be viewed in a new perspective. He is no longer a mendicant scholar who would otherwise be unemployed. Today, instead of embarking on a long period of hard work without income in order to secure a higher degree, he is tempted to enter the labour force for the sake of immediate high wages. The kinds of students who willingly undertook advanced studies out of sheer interest, love of learning, and sense of vocation, caring little for comfort or security, simply do not exist in sufficient numbers; nowadays there must be the added incentive of assured maintenance and future fiscal rewards. In fact, financial support for graduate students, and in many instances for their families, is needed as never before.

Three types of increased support for graduate studies in the humanities and social sciences are urgently needed: fellowships, government loans, and grants to meet expenses incurred by students in carrying out their doctoral research project. With regard to fellowships, it is noteworthy that the National Research Council of Canada made its awards for graduate study tenable only in Canadian universities, thereby encouraging in those institutions the development of strong graduate departments in the natural sciences; whereas the fellowships for graduate study provided for several years by the Humanities and Social Science Research Councils, and for the past decade by the Canada Council, have been tenable at universities either within or outside Canada. Not until 1967-68 did the number of graduate students holding Canada Council fellowships at Canadian universities approach the corresponding number at foreign universities. The Canada Council might well consider reviewing the pros and cons of its present policy on this question.

The need for increased support of graduate students through government loans requires no argument here. Less self-evident is the need for grants to meet the costs of conducting their research activities. The Ph.D. student in physics may depend upon equipment costing many thousands of dollars. Such costs of graduate studies in the sciences have long been recognized. In the humanities and social sciences, however, the assumption has been that nothing more was required than financial support for the graduate student himself, in the form of fellowships and loans. Increasingly, such students undertake research projects whose actual performance costs money. To cover these expenses through grants made to staff members supervising the research is often an unsatisfactory system, for the research interests of the graduate student in the humanities and social sciences may differ considerably from those of his thesis supervisor. Some device must be worked out to cover expenses of this kind.

Libraries and Archives

The importance of libraries to humanists and social scientists arises from their dependence upon books and documents rather than upon facilities for physical experimentation. For them, major research libraries are the counterpart of major research installations for the scientist. The shortage of such institutions in Canada impoverishes our national life.

The library situation in this country is midway between that in Britain, where even the quality of newspaper reviewing or of the B.B.C. Listener is directly related to British Museum book holdings, and the situation in Australia, where the universal inadequacy of libraries is a hindrance to all types of academic inquiry. Canada is fortunate in having some use of American resources, but these, however generously made available, will not take the place of our own institutions. Nor should we allow them to do so. We may congratulate ourselves upon the possession of a National Library and National Archives building in Ottawa; but we should also reflect upon the strangely unresponsive governmental system and the remarkably apathetic community that required so much campaigning before they visibly embodied their national concern for the written word, at the end of a century of federal existence.

The assumption that the growth of Canadian libraries in the past decade had put them above the poverty line in respect of materials held, proves fallacious when we consider the growth of student population, the increase in graduate work, and the wider range of subjects covered, to say nothing of in-

creased numbers and activities of university staff. Applying a formula taking all the above factors into consideration, P.E. Downs has shown that deficiencies below the level of reasonable requirements were as follows, in a few representative institutions in 1965-66:-

| <u>Institution</u> | <u>Number of volumes deficient</u> |
|--------------------|------------------------------------|
| British Columbia | 1,210,885 |
| McGill | 721,594 |
| Manitoba | 436,972 |
| New Brunswick | 282,306 |
| Queen's | 528,367 |
| Western Ontario | 525,060 |

The survey indicated that for adequate research to be conducted in Canadian universities, the holdings of their libraries would have to be approximately doubled. Many French-Canadian libraries are in an embryonic state.

It is unrealistic to suggest that provincial governments should be relied upon to correct this growing deficiency through their annual budgetary grants to universities. One of the greatest needs is for big collections, particularly of related materials, and the acquisition of such collections, often only briefly available on the market, is unlikely to appeal to a provincial government. The word "provincial" has acquired a connotation of "less than liberal" from the need, felt by the governments of even Roman provinces, to guard against supposed extravagances and to respect local caution. The senate, even in Roman history, was expected to enjoy a wider view.

The part played by libraries in making Canada a place that scholars wish to stay in deserves especial stress. We are bound to lose first-rate (or potentially first-rate) scholars if we do not make available the full range of research facilities the international market demands: particularly if we lack big collections, such as have contributed to make Harvard, the Library of Congress, and the British Museum what they are - places of freedom and excitement to the scholar, because in them he can continuously expand his range of references, and by following many lines of thought can find the pattern of relationships and cross-fertilizations that is the substance of culture.

A vigorous and accelerated effort is needed to make Canadian government documents and records available to scholars. A liberal policy on access is vital to a proper interpretation and understanding of our society and the working of our institutions. The United Kingdom has established a "thirty-year rule" as a basis for access, replacing the fifty-year rule formerly in effect. The Canadian Government should follow suit without delay, making its records available to qualified researchers after the lapse of three

decades. In many instances it should be possible to allow access to records before they are thirty years old.

Finally, since this kind of research generally presupposes the intention to publish, it may be noted here that the present arrangements for support, involving e.g. a conjunction of the Humanities Research Council, The Social Science Research Council, the Canada Council, and one of the university presses, are efficient and deserve the gratitude of those they serve. The system by which academic freedom is preserved, while the Council avoids the onus of subsidizing publications that might offend some sections of public opinion, should be jealously guarded in any reorganization or expansion of support for this branch of scholarly activity.

New Facilities of Research

In addition to libraries and archives, humanists and social scientists increasingly require such facilities as data banks, computer centres, survey centres, and centres for statistics and for information retrieval. Much social science research involves analyses based on large samples or total populations, and depends upon computers for processing large bodies of data and subjecting them to sophisticated statistical procedures. In the humanities also these new techniques are increasingly used. The fields of language and literature, for example, offer important opportunities for experimental research in phonetics and in literary judgments, supported by computer analysis of imagery and vocabulary. The acquisition of the necessary technical facilities calls for direct federal government support.

Grants in Aid of Study and Travel Abroad

The building up of resources and improvement of services in Canadian libraries might be supposed to obviate or greatly reduce the need for travel abroad by Canadian scholars. Such a conclusion takes little account of the global interaction of research activity. Canadians must continue to go beyond the borders of their own country, to find sources in other libraries and collections, to exchange ideas face to face with foreign scholars, to give their papers and hear those given by their peers, to attend conferences, in some instances to do field work. The stay-at-home scholar runs a continuous risk of sinking into parochialism and becoming content to gauge ideas by local standards.

To refer to the financing of travel and study abroad as an area of crisis may appear ungracious to the Canada Council, in view of its immense services in this regard. In the past, however, the Council has more than once

found that legitimate and fully documented needs have outrun its resources. Only the Council's fullest vigilance and the Government's goodwill can prevent a recurrence of this situation.

RESEARCH IN FRENCH CANADA

All the factors considered under the last heading "Areas of Crisis" apply with special cogency to French Canada. In our bilingual and bi-cultural country, consideration should be given to any peculiar problems or situations pertaining to research encountered by Francophone scholars. Their general aims and methods, and attitudes towards the humanities and social sciences, of course show no essential differences from those prevailing in other parts of the country. Yet research in these disciplines has only recently started in Quebec, despite the long tradition of classical scholarship in its colleges. However, considerable progress has already been made, and the importance of research is now more generally recognized. Research centres, institutes and associations have been established by governments, universities and by industry; and there are flourishing learned societies where scholars meet to discuss their findings. There have also been much-needed improvements in library resources, language laboratories, information-retrieval centres, and similar facilities.

Notwithstanding these advances, they are far from meeting present needs, let alone the foreseeable greatly expanded demands. Much costly human and material effort is disproportionately diverted to the teaching of elementary techniques, already familiar elsewhere. Moreover, though research activities are quite well organized in some sectors, they lack over-all co-ordination. Great benefits might come from a central organization, whose functions would be to stimulate and co-ordinate research endeavour; to assign research teams to priority projects; to avoid costly duplication and overlapping; and to ensure the equitable and prudent distribution of funds.

The shortage of research workers in all fields is very pronounced in Quebec. Proper graduate schools are of comparatively recent establishment; and since too few research supervisors are available and their teaching load

is far too heavy, research programmes tend to be loosely defined, and may be unrealistic in terms of the material and human resources of the institution concerned. Resolution of these difficulties, in Quebec as elsewhere, would appear to require freeing some of the best-qualified research-minded teachers from at least part of their teaching load; providing them with research assistants who could assume some of their teaching responsibilities; and encouraging the more able students to take graduate work by increasing the number of assistantships and scholarships. In sum, remedies for the problems of research in the humanities and social sciences in French Canada include those common-sense palliatives and scarce specifics which have been prescribed already in this submission for the whole nation. Only the patient's sense of isolation, and a somewhat aggravated symptom-complex, add to the general anxiety about the outcome.

FINANCIAL CONSIDERATIONS

Following the publication of the "Bladen Report", rough estimates have been made of future needs for financial support of research in the humanities and social sciences. In making such estimates, special attention should be paid, in the interests of economy and efficient operation, to the employment of non-professional staff, such as stenographers, tabulators, duplicators, bibliographers, technical assistants, etc. The proportion of such workers in the universities has always been low, from a natural but mistaken reluctance to pay money to anyone not carrying a teaching load. This policy, even in times of financial stringency, was a doubtful economy, as anyone knows who has worked with and without an assistant. Today it is absurd and in the near future will become calamitous. Already, in government and business, professional researchers in the social sciences are furnished with assistants in a ratio approaching one to one.

Support for Graduate Students

Figures submitted in the Canadian Association of Graduate Schools Brief of 1965, and in the subsequent C.A.C.S. Report that revised some of those estimates, claim our attention. They represent the estimated support, past and projected, for graduate students in the humanities and social sciences:

| | |
|---------|----------------|
| 1964-65 | \$ 6½ millions |
| 1970-71 | 52½ " |
| 1975-76 | 140 " |

Students engaged in post-doctoral research represent an important and growing class. The revised estimates of the Report suggest that, although in 1964-65 there were in Canada only about 15 post-doctoral fellows in the

humanities and social sciences, future enrolment will probably amount to 2% of all graduates, and the levels of support required will rise from \$3½ millions in 1970-71, to \$9 millions in 1975-76. The extent of this expected growth and the necessity of encouraging it derive from the rapid expansion of specialization in many fields and the development of inter-relations among disciplines.

Provision of Staff

Perhaps the least obvious but certainly not the least pressing financial problem related to research in the universities, is that of providing staff of adequate quality and quantity. Not many years ago it was generally assumed that teaching staff carrying full loads could supervise theses effectively in their spare moments. At a time when this entailed occasional consultations with an M.A. student working in the field of the staff member's special interest, this view had a certain plausibility. It no longer has any relation to the facts. The Report cited above estimates that salary requirements are likely to increase as follows, even on a very modest estimate of rising pressure in the market for staff capable of skilfully directing and supervising graduate work in the humanities and social sciences in this country:

| | |
|---------|------------------|
| 1964-65 | \$ 12.7 millions |
| 1970-71 | 43 " |
| 1975-76 | 106 " |

Non-professional Assistance

The need for non-professional assistance has already been mentioned. It is especially difficult to estimate costs in this connection, because of rapidly changing conditions of research. (Only within the last year, for example, has the computer-compiled index become a tool in the history and criticism of Canadian literature). However, from estimates made in the same Report, the following forecast of expenditures under this heading seems plausible:

| | |
|---------|-----------------|
| 1964-65 | \$ 1.6 millions |
| 1970-71 | 13 " |
| 1975-76 | 30½ " |

General Considerations

It is a commonplace caution that all rising graphs should be scrutinized for credibility in a context larger than the data upon which they are constructed. Had certain rising trends in American education at the turn of the century continued their upward climb, the whole population of the United States would now be candidates for ordination in the Methodist ministry.

Self-evidently, the figures cited above should not be extrapolated to infinity by around the turn of this century, since a levelling trend in the rising costs may be anticipated long before then. However, as industrialization

and technological exploitation of the country's resources proceed hand in hand, giving rise inevitably to questioning and re-examination of social values, we may confidently expect the humanities and the social sciences to come increasingly into play; for such values are within their special competence and concern.

As regards the sums involved, the purpose of this brief is to demonstrate values and needs, to stress the urgency of the national problem, and to suggest the order of magnitude of the financial support soon to be demanded by the situation. If humane values, massive needs and critical urgency are accepted at their full significance, it should not be difficult for government to arrive at a proper statistical basis for future policy.

THE RELATION OF RESEARCH IN THE HUMANITIES AND SOCIAL SCIENCES
TO NATIONAL INSTITUTIONS

Research in the humanities and social sciences is a concern of several institutions in Canada, e.g. the Canada Council, the Humanities Research Council, the Social Science Research Council, the Canadian Council of Urban and Regional Research, the Royal Society, the National Library and National Archives, the National Gallery, some of the Learned Societies, and the Universities. With the exception of the last two, all have their headquarters in Ottawa. The relation of these various organized bodies to the actual pursuit of research differs widely. Some are channels through which financial support reaches the researcher; some possess resources indispensable to him; and in some the scholar may be a corporate member. Each of these bodies has a necessary role in the effective and economic pursuit of research in the humanities and social sciences in this country. Their respective roles will not be discussed here, but the following two comments seem pertinent.

With regard to the Universities, although they are not centrally controlled or financed, there is evidence that the Association of Universities and Colleges in Canada and the Canadian Association of Graduate Schools do serve as an effective nexus for gathering, analysing and transmitting information, statistics, opinion and ideas. The role of the A.U.C.C. has been a continuously and fruitfully expanding one: its increasing future usefulness is predictable.

The weakest organization is in the area of the Learned Societies. These societies would be greatly strengthened and their relation to research clarified if a central secretariat, which need not be elaborate, were set up in Ottawa. At present, records are at the mercy of secretaries with short

terms of office; there are few if any provisions for gathering, sorting out and exchanging data of common concern; and the vital matter of liaison with counterparts in the United States goes largely unexplored.

Clarification and Co-ordination Preferable to Institutional Change

Among steps taken in recent years toward recognition of national policies in humanistic and social science research, are the establishment of the National Library and National Archives, the recognition that the Canada Council needs more than a fixed endowment, and many improvements in corporate organization such as the strengthened secretariat of the Royal Society. Humanists and social scientists however, are still painfully unaware of what their fellow scholars are doing, of the administrative mechanisms by which research is furthered, and of the channels, open or potential, through which information of many kinds relevant to research might be exchanged. Pending the publication of the "Macdonald Committee" report, it is perhaps premature to suggest what specific steps might be taken to co-ordinate effort, clarify aims and exchange information. In the meantime, attention should be drawn to the importance of supplying this need for a central clearing-house and co-ordinating organization.

The institutions themselves are not, in our view, in need of radical change. In particular, the Canada Council should not be tampered with, for three compelling reasons. First, the Council works with steadily increasing efficiency, scope and discrimination: it has, by its probity, secured a large measure of confidence from the public and the legislative bodies. Secondly, in Canada there is a perennial lag in the legislative programme; regardless of proposed improvements in parliamentary procedure, there seems no likelihood of any reduction in this lag. If the question of sub-dividing the Council were to come before the Government, there might well result a freezing of research support at present levels, until new proposals (for better or for worse) could be framed - a delay of probably three or four years. Thirdly, and most dissuasive, if new federal agencies are proposed in the fields of the humanities and social sciences, conceivably several of the larger provinces might demand that these federal agencies withdraw from direct support of research and allocate corresponding sums to the provincial governments to be expended at their discretion - with consequences that may be imagined.

The Canada Council maintains a delicate but not precarious balance of interests that on the whole works very well. However, the Council might be well advised to consider the desirability of ensuring that its membership

include at least one direct nominee from each of those bodies representing the main disciplines within the Council's purview - in particular, from the Humanities and Social Sciences Research Councils. Other proposals have been made which in our opinion would work very badly, e.g. the fragmentation of the Council into smaller bodies dealing separately with the performing arts, the social sciences, and so on; or alternatively, an omnibus body concerned with grants to disciplines ranging from creative writing to the medical sciences - a range of interests it would be excessively difficult to keep in perspective.

* * * * *

In presenting this brief to a committee of the Senate, we are reminded that the problems surveyed are truly national. A widespread fallacy exists that education is under exclusively provincial jurisdiction. It is scarcely necessary to recall to members of Senate that the relevant section of the B.N.A. Act directs that "in and for each Province the Legislature may exclusively make Laws in relation to education". This leaves wide open the question of education that is not "in and for each province", but of national magnitude. Though political measures are required to support research, its objectives are not political, nor are they federal in their scope or provincial in their aim, but rather national in the sense of striving toward an enduring cultural ethos. Michelangelo's staircase leading to the senate house in Rome achieved a uniquely comprehensive view of the Campidoglio beneath and a vista into the City. Michelangelo was seldom mistaken in his intuitions.

REFERENCES

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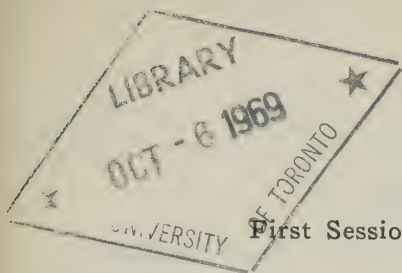
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First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 55

THURSDAY, JUNE 5th, 1969

WITNESSES:

The Chemical Institute of Canada: Dr. Norman S. Grace, President, Dr. H. S. Sutherland, Past-President, T. H. Glynn Michael, General Manager and Secretary, Mr. W. H. C. Simmonds, Director of Membership and Growth; Dr. Pierre Grenier; Canadian Association of Physicists: Dr. Morrell Bachynski, President, Dr. Lynn E. H. Trainor, Honorary Secretary-Treasurer.

APPENDICES:

- 113.—Brief submitted by the Chemical Institute of Canada.
114.—Brief submitted by the Canadian Association of Physicists.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

THURSDAY, June 5, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 8.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Carter, Grosart, Kinnear, Robichaud and Yuzyk—6.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*); Gilles Paquet, Director of Research (*Human Science*).

The following witnesses were heard:

THE CHEMICAL INSTITUTE OF CANADA

Dr. Norman S. Grace, President

Dr. H. S. Sutherland, Past-President

T. H. Glynn Michael, General Manager and Secretary

Mr. W. H. C. Simmonds, Director of Membership and Growth

Dr. Pierre Grenier

CANADIAN ASSOCIATION OF PHYSICISTS

Dr. Morell Bachynski, President

Dr. Lynn E. H. Trainor, Honorary Secretary-Treasurer

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

113—Brief submitted by the Chemical Institute of Canada

114—Brief submitted by the Canadian Association of Physicists

At 10.00 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

Curriculum Vitæ

Bachynski, Morrel P. F.R.S.C., F.A.P.S. President, CAP. Research Director, R.C.A. Research Laboratories, Montreal. Born in Saskatchewan, 1930. B.Eng.—Saskatchewan, 1953. Ph.D.—McGill, 1955. R.C.A., 1955 to present. Fields of interest: electromagnetic wave propagation, microwave optics, plasma physics, geophysics and space physics. David Sarnoff Gold Medal, 1963. Member of the Physical Society and CAP, Associate Fellow Canadian Aeronautical and Space Institute. Vice-President, CAP, 1967-68.

Grace Dr. N. S. Born: Naini Tal, India, August 15, 1906. Technical Training: B.Sc. (gold medal) & M.Sc. Chemistry, University of Saskatchewan 1927 & 1929; Ph.D. London 1931. Post Doctoral Fellow University of California, Berkeley 1931-33, Physics Department, University of Toronto 1933-35. Professional Career: Research Chemist, Gutta Percha & Rubber Co., Toronto, 1935-37; Research Chemist, under Dr. G. S. Whitby, National Research Council, Ottawa, 1939. With Dunlop since 1939 starting in laboratory and plant process control; Chief Chemist 1940 on leave majority of time 1942-44 to Canadian Government Synthetic Rubber program, 9 months Washington representative; remainder Manager, Technical Service Division, Polymer Corporation. Technical Superintendent, Dunlop Canada Limited, 1945-54. Present position since June 1954. Activities: Chairman Ontario Rubber Group 1940-41; 1941-42; Chairman Toronto Section CIC 43-44; Chairman Exhibits Committee Chemical Conference 1944; CIC Councillor "A" 1945-48; CIC Councillor "B" 1954-57; First Chairman Division of Rubber Chemistry, CIC, 1945-46. Member, National Research Council Committee on Synthetic Rubber Research 1945-52. Founding member and Past Chairman, Canadian Research Management Association; Company representative Industrial Research Institute, New York, Chairman, Ontario Research Community Organizing Committee 1960-61. Current President Sheridan Park Association, Director Sheridan Park Corporation. Chairman Chemical Engineering Sub-Committee Queen's University Engineering Advisory Council. Past Chairman, Division of Rubber Chemistry, ACS, first Canadian to hold this position. Participated in first seminar on "Management of Industrial Research" sponsored by IRI at Harvard Business School in 1959. Recently made life member Ontario Rubber Group. Founding Director Infors Computers Limited. Extra Activities: President, Oneida Country Club. Founding Director Toronto Striders Track Club. Past Warden and current Chairman Property Committee for Church of the Redeemer, Toronto. Honours: Fellow, American Association for the Advancement of Science. Fellow, Chemical Institute of Canada. Fellow, Institution of the Rubber Industry of Great Britain. Family: Two sons, one daughter. Interests: Fishing, Hunting, Golf, Tennis, Hockey.

Grenier, Pierre. Born August 15, 1922, Quebec City. University degrees: Bachelor of Arts 1942, Laval; Bachelor of Applied Sciences (Chemical Engineering), 1946, Laval; M.S. in Chemical Engineering, 1947, Columbia. Career and academic activities: Lecturer, Chemical Engineering Department, Laval, 1947-50; Agrégé (Professor), Chemical Engineering Department, Laval, 1950-55; Titular professor, Chemical Engineering Department, Laval, 1955;

Associate professor, Faculty of Sciences, Nancy, and lecturer at ENSIC, Nancy, 1963-64; Head of Chemical Engineering Department, Laval, 1965. Extramural activities: Consulting Engineer with CARDE; APUL Secretary; Head, Professional Affairs, Chemical Institute of Canada; Chairman, CNR Selection Committee (Chemical and Metallurgical Engineering). Present Teaching: Transfer phenomena. Scientific Works: Area: fluidization; Supervision of: 1 graduate student; Publication of: 10 articles; Present grants: \$10,000.

Michael, T. H. Glynn. Upper Canada College, Toronto; University of Toronto, Honours Chemistry 1940; Ontario Research Foundation; National Research Council, Protective Coatings Laboratory; Woburn Chemicals Limited, Chief Chemist; Howards & Sons (Canada) Limited, Director of Research; The Chemical Institute of Canada, General Manager since 1958; Held a number of elected offices in The Chemical Institute of Canada, including that of Treasurer (1953-56) before becoming General Manager; About twenty publications, dealing with various aspects of the chemistry of protective coatings and of organization management. Married, three children. Treasurer, Youth Science Foundation; Director, Institute of Association Executives; Member, American Association for the Advancement of Science; Membre d'Honneur de la Societe de Chimie Industrielle de France; Vice-President and President-Elect, Council of Engineering and Scientific Society Secretaries.

Simmonds, Walter Henry Clive. W. H. Clive Simmonds, of the development department of Canadian Industries Limited, was born in London, England and educated at Bickley Hall Preparatory School and Brighton College. He graduated from Oxford University with an M.A. and a B.Sc. in chemistry. Before coming to Canada he did research and development work with Lever Bros. and Unilever Ltd. and was responsible for the establishment of a post-graduate school of chemical engineering at the University of Durham, Kings College, Newcastle-on-Tyne. He came to Canada in 1952 and continued his research work as assistant to the director of research with Dominion Tar & Chemical Company in Montreal. In 1956, he joined the development department of CIL, and is at present Project Head in the Corporate Planning Office.

Mr. Simmonds played a leading role in creating interest by the chemical and chemical process industries in Expo '67, and was seconded by CIL to the Theme Group for one year, at the request of the Canadian Corporation for the 1967 World Exhibition. He was also a leading Toastmaster in District 61, Toastmasters International, and combined his interest in Expo '67 and public speaking as a member of Expo's Speakers Bureau. He was Programme Chairman for the 1967 Congress of Canadian Engineers, the first occasion on which all the eleven engineering societies in Canada met together. He was Secretary of the Tripartite Chemical Engineering Conference held in Montreal in September 1968, the first occasion on which chemical engineers from Canada, Britain and the United States have met together.

Mr. Simmonds is a Fellow of The Chemical Institute of Canada, and its present Director of Membership and Growth. He is a member of the Institution of Chemical Engineers and a Chartered Engineer in the United Kingdom. He is a member of the Corporation of Professional Chemists of Quebec and of the Canadian Society for Chemical Engineering, of which he is Chairman of the Conference and Symposia Committee. He is a member of the American Institute

of Chemical Engineers and is the Canadian representative of its Foreign Relations Committee.

He has published papers in the fields of organic and medicinal chemistry, the drying of wheat, mixing, and the basic mechanisms which control expansion and profitability in the petrochemical industries of the United States and Canada.

Mr. Simmonds was invited to lecture on "Engineers and Society" at Sir George Williams University and commenced this in 1968. He is also an honours student in Sociology at the same university.

Sutherland, Hugh S. Title: Vice-President, Gulf Oil Canada Limited. Place of Birth: Amherst, N.S. Education: Mount Allison University—1928—B.Sc. 1963—LL.D. (Honoris Causa) McGill University—1929—M.Sc. 1931—Ph.D. (Physical Chemistry) Imperial College of Science & Technology—1935—D.I.C. (Chemical Technology). Employed as a summer student by Shawinigan Chemicals Limited during undergraduate and post-graduate years. Joined Shawinigan Chemicals Limited in Plant Research Laboratories 1931. Research Chemist 1931-42. Works Manager—St. Maurice Chemicals Ltd. 1942-45 (a wartime subsidiary). General Sales Manager (Shawinigan Chemicals) 1945 (Director of Company 1946). Vice-President Sales 1947-56. Executive Vice-President & General Manager 1956-58. President 1958-66. Chairman of the Board 1966-Apr. 1/69. Vice-President—Gulf Oil Canada Limited 1967-to date. Past President & Past Chairman of Board—The Chemical Institute of Canada. Past Chairman—Society of Chemical Industry, Canadian Section. Past President—Montreal Board of Trade. Past Member of Advisory Council, Export Credits Insurance Corp.

Trainor, Lynn E. H. Honorary Secretary-Treasurer of CAP. Professor of Physics, University of Toronto. Born in Saskatchewan, 1921. B.A.—Saskatchewan, 1946; M.A., 1947. Ph.D.—University of Minnesota, 1951. NRC postdoctoral fellow, 1951-52. Assistant Professor, Queens University, 1952-55; University of British Columbia, 1955-56; University of Alberta, 1956-57. Associate Professor, University of Alberta, 1957-63. Professor, University of Toronto, 1963 to present. Fields of interest: statistical mechanics, astronomy, elementary particle physics, and nuclear structure theory. Member of American Physical Society, Royal Astronomical Society of Canada and CAP. Secretary, CAP, 1966-68.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Thursday, June 5, 1969

The Special Committee on Science Policy met this day at 8 p.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have this evening the pleasure of receiving representations from The Chemical Institute of Canada, a subsidiary of The Chemical Institute of Canada, the Chemical Education Division. Also we have representations from the Canadian Association of Physicists. As usual we will have the opening statements. I understand that The Chemical Institute of Canada is more numerous, so since it is an exercise in participating democracy I will first ask the representatives of The Chemical Institute to make their opening statement.

We have with us this evening from that institute Dr. Grace, who is the new president of the Institute; Mr. Michael who is the Executive Director of the Institute. I understand that Mr. Michael would like first to introduce the delegation from the Institute and then Dr. Grace will speak to us.

Mr. Michael.

Mr. T. H. Glynn Michael, General Manager and Secretary, The Chemical Institute of Canada: Mr. Chairman, honourable senators, we have with us representing The Chemical Institute of Canada this evening first, as we have heard, Dr. Norman Grace, who has been president for only a few days but who was vice-president for a year before that. He is manager of the Dunlop Research Centre. We have with us Dr. H. S. Sutherland, who is a past president of The Chemical Institute of Canada and who is vice-president, Gulf Oil Canada Ltd. We have also with us Dr. Pierre Grenier, Doyen, Faculté des Sciences, Université Laval. He is a chemical engineer by training and profession. We also have with us Mr. W. H. C. Simmonds who is a director of the Institute, as is Dr. Grenier, and who in

private life is associated with the corporate planning department of Canadian Industries Limited.

I think, Mr. Chairman, that in this group we have individuals who are sufficiently knowledgeable in all phases of the activities of The Chemical Institute of Canada and of the chemists and chemical engineers who comprise it to answer, or to certainly comment on, questions which members of your committee would put.

The Chairman: I am sure you will not be able to answer all questions.

Mr. Michael: That is why I said they will comment on. In addition to this, perhaps, at the conclusion of the question period Mr. Simmonds would like to enlarge on an area which was not covered in any great depth in the Institute's brief.

I would like to ask Dr. Grace to present the opening statement.

Dr. Norman S. Grace, President, The Chemical Institute of Canada: Mr. Chairman, honourable senators, may I first briefly review our large and dynamic association, The Chemical Institute of Canada, and then I will tell you something of our thinking and recommendations on Canada's science policy in relation to the brief submitted a few months ago. The Chemical Institute of Canada is a national, non-profit organization with a federal charter. It offers membership to all who have a special training or interest in chemistry or in the sciences, engineering, technologies or businesses in which chemistry is involved.

Approximately two-thirds of the present over 9,000 members are practicing chemists or chemical engineers with employment covering virtually all segments of the public and private sectors of the country. Members of the Institute are found at all levels, from laboratory bench workers and lecturers to corporation and university presidents. There are about 3,000 student members from uni-

versities, technical institutes and community colleges. The Institute operates from the Atlantic to the Pacific through local sections and student chapters at every location of chemical significance in this great country of ours. It comprises 11 subject divisions and one constituent society.

Now I would like to just review briefly our principal objectives. Parenthetically, Mr. Chairman, you may be interested in the fact that we have recently revised and updated these objectives. I believe that the formation and activities of your committee have been strong motivating factors in this, so you are starting to bear fruit, gentlemen, even a little fruit. Apart from serving the interests of its members, I would like to mention three main areas of objectives: the first is to work in the national interests where chemistry may be concerned. This is done in three ways: first of all, co-ordination of educational and professional standards and the encouragement of the elevation of these, recognizing that jurisdiction in these fields is a provincial responsibility; (b) advice to governments, their agencies or other bodies in the development of science policies or other matters; (c) co-operation or joint action with other national and international scientific, technical, educational or professional organizations.

Then another area of objectives, to advance the science, engineering and technology of chemistry and related fields.

Finally, and this is one that Mr. Simmonds would like to develop at the end of the discussion: to fulfil its responsibilities to society as a whole in those areas or problems which involve both technology and society.

The Institute serves its members and the informed public through a series of meetings and conferences, plus three publications. The conferences are national, international and regional. I might say that in a 20-month span we will be involved, and we have been involved in three and will be involved in two more, a total of a five international meetings, which is quite significant. These meetings cover a very wide range of subjects directly related to the breadth of interest of the Institute members. These range from the very practical division of chemical economics to the academic division of chemical education. It includes the technological divisions of rubber and protective coatings, the fundamental divisions of macromolecular sciences (that is polymers and the like), inorganic, organic, physical and analytical chemistry. Then there

are two divisions closely allied to the life sciences, medicinal chemistry and biochemistry. Finally, the constituent organization, The Canadian Society for Chemical Engineering, emphasizes the technological and industrial aspects.

The Institute's activities provide forums for the interchange of views on all aspects of chemistry and chemical engineering. It permits their interaction with other sciences, with industry, education, government and the community at large, thus promoting communication, co-operation and better understanding between them and helping to reduce isolation, increasing opportunities for cross-fertilization of ideas. The Institute has recently completed a major study of chemical research in university, government and industry in Canada under contract with the Science Council of Canada.

Times does not permit me to give you a fuller account of the broad scope and national importance of our Institute in the scientific and technical life of Canada.

Now I would like briefly to highlight some of the thinking and some of the recommendations related to our brief.

First of all, in line with the Institute's objectives I have just mentioned, we would like to stress our desire to contribute in a constructive way and on a continuing basis to the development of science policy in Canada. We recognize that our science policy must be a part of our overall national policy. Further, that in order to contribute to such national objectives as expanding the economy through technological innovation, science must be used—it must be applied. This involves many things: a favourable economic climate, sufficient people well-trained in many skills and disciplines, adequate facilities, modern information services, plus improved communication and co-operation between the main sectors efficiently to generate and use new science and technology.

Now a word about this question of sufficient trained people. It is very important that we organize our forward supply of trained manpower so that our precise requirements can be filled, both as to numbers and types of education and training, while avoiding excessive over-supply. This is a national problem with many regional ramifications. It needs planning. We therefore, recommend national planning to give leadership and to co-ordinate federal support in this important area.

Now the question of national information services. Competitive research, development and innovation require ready availability of the total relevant information. This must cover the vast amount of science and technology that is flowing into Canada, plus the information being developed here. We therefore recommend a national information service organized to take full advantage of modern automated procedures and equipment for efficient storage, retrieval and dissemination of information with remote access.

Now the question of improved communication. The rapid and accelerating rate of change demands improved communication. Our diversity of interests and great distances are part of the problem. Scientific journals and scientific associations can make a worth while contribution. We therefore recommend that the Government extend partial financial support to approved national scientific associations, particularly in the field of scientific publications and lecture tours of distinguished scientists, technologists and the like.

Improved co-operation. In the national interests, it is important to organize our scientific and technical capabilities so as to optimize their effectiveness. We therefore recommend that the Government study this area and consider contracting out research projects for civilian purposes to collective groups from universities, government agencies and industry, thereby improving co-operation and evolving diversified teams to better solve the nation's scientific problems.

Finally, a word about the economic climate and its improvement to encourage innovation in Canada. The commercial application of new knowledge—innovation—is largely related to social and economic policies, tariffs, taxes, incentives, etcetera. It is therefore recommended that the Government take steps to improve the economic climate to encourage innovation in Canada.

That completes our brief statement, Mr. Chairman.

The Chairman: Thank you very much, Dr. Grace.

Now we will hear from the Canadian Association of Physicists and, in particular, from its President, Dr. Morell Bachynski, who was asking me questions last Monday in Toronto.

Dr. Morell Bachynski (President, Canadian Association of Physicists): Mr. Chairman, honourable senators: Let me begin by intro-

ducing my colleagues. On my immediate right is Dr. Lynn Trainor, Professor of Physics, University of Toronto; and sitting on my right also is Monsieur Jean-Louis Meunier, Executive Secretary of our association.

The Canadian Association of Physicists, or CAP, as the national organization whose aim is to promote physics and its applications to society, is pleased to have this opportunity to appear before the Special Senate Committee on Science Policy. The Association has in its membership more than half of the professional physicists in Canada and thus represents the most democratic voice of the physics community in this country.

Physics is the branch of knowledge concerned with the discovery and elucidation of those natural laws which determine the nature of our physical environment. It permeates the culture of our society through our curiosity about ourselves and our natural environment. Because of our dependence on technology and its relevance to physics, physics has much to contribute in attempts to find solutions to the increasing social problems facing our society. Finally, physics is that branch of human knowledge upon which all of the physical sciences and most of engineering is based. Thus, physics has given rise to technological developments of immense economic importance such as the aircraft industry, the optical industry, the communications industry, the transportation industry, the computer industry and the nuclear power industry, to name only a few.

In a recent attempt by the National Inventors' Council of the U.S.A. to identify the top ten technological inventions of the past 20 years, the contenders included the transistor, the laser, holography, integrated circuits, colour television, fibre optics and satellites and rockets. All of these depended heavily on physics during their inception and development. However, although physicists probably generate the new ideas and principles behind more products than do any other type of scientist, they are themselves only a small part of the total group extensively involved in a professional way in the long process of developing a research discovery into a marketable product. The talents and skills involved are many and are provided in varying degrees by pure scientists, applied scientists, development engineers, mechanical and production engineers, sales personnel, economists, lawyers, managerial staff, and so forth.

The membership of the Canadian Association of Physicists has been actively concerned

with the status of physics in Canada, particularly since completion by the Association of the Science Council Special Study No. 2—Physics in Canada—Survey and Outlook. The specific concerns and recommendations of the community of physicists as revealed in that report, through subsequent projects and in a recent survey conducted by the committee on the preparation of this brief to the Senate committee, can be summarized as follows:

Firstly, there exists a need for more effective communications between scientists, government and the public. It is considered that the mechanism for making science policy in Canada needs to be clarified and that communications need to be improved between those in Government who set science policy, the members of the scientific community and the public at large. The members of the science community feel that they require direct representation on those agencies of Government that effect science policy, including Treasury Board. The Canadian Association of Physicists is willing to play whatever role it can towards achieving these objectives.

Secondly, there exists a need to support physics research as a contribution to the social, cultural and economic well-being of Canada. Specific recommendations include:

(i) The research effort in applied physics requires strengthening by encouraging universities to undertake more research oriented towards applied physics in order to improve the flow of graduates with an interest in such work and by developing physics research in industrial laboratories. The latter relates directly to the problem of providing young Canadian scientists the opportunities to pursue meaningful and productive careers in Canadian industry.

(ii) The support for all forms of research in basic and applied physics that are connected with the conservation or national exploitation of our natural geography and our national resources should be greatly increased.

(iii) Fields of research for which our terrain and location give a natural advantage over other countries need to be maintained at an adequate level, and, where necessary, have increased support.

(iv) The development of large national interdisciplinary research facilities which emphasize both the university and industrial communities should be encouraged.

(v) A proper balance between basic and applied research needs to be established since these are fundamental to each other and to the flow of ideas into development and innovation. Thus fields of physics which are currently successful should continue to be supported at a rate which will maintain or improve their position, theoretical physics should be given sufficient support to enable it to come into balance with experimental physics in all fields, and pure physics should continue to be adequately supported in order that it will always form an adequate base for the increased engagement in applied physics indicated earlier.

To achieve the above objectives, the recommended average annual increase in the support of research in physics is 23 per cent per annum over the next five years. This should be made up of a 25 per cent annual increase to the universities, a 15 per cent annual increase to government laboratories and a 44 per cent annual increase in the support of physics research in industry. Consistent with this, the federal Government grants for the support of physics research need to be increased at an annual rate of 36 per cent over the next five years.

Specific suggestions on the implementation of these recommendations on support of physics research in the universities, in industry and in the government laboratories are contained in the body of our brief and in more detail in the Special Study No. 2—Physics in Canada—Survey and Outlook.

Thirdly, there exists a need for education in physics which requires that steps be taken, primarily through the schools and the communications media, to bring the scientist and the public together in an atmosphere of common respect and concern for social, political and economic issues. In today's language this means improving science education for society and social education for the scientist.

Similarly, efforts are required to educate industrial entrepreneurs to the advantages of a science-trained and research-oriented managerial class in providing innovation and improving the production and marketing of Canadian products. In addition, the liaison between university scientists involved in basic research, and industrial scientists and development technology needs to be improved.

Fourthly, there exists a need for the national scientific associations such as the Canadian Association of Physicists to under-

take a more active role in socio-scientific projects. Projects on physics and society, history and philosophy of physics, manpower, information analysis and retrieval, and, to a lesser degree, physics and education are generally neglected in Canada. This is a particularly unfortunate situation since it is these activities which determine the degree of maturity of a science in Canada, its relevance, and, in particular, its Canadian identity. The social development of modern physics and its intellectual and economic impact on Canadian society should be of vital concern.

It is, therefore, necessary that the essential role of scientific societies in the development of a scientific discipline be recognized. This can be achieved by setting aside a fraction of the national budget in a given discipline (say $\frac{1}{2}$ of 1 per cent of the total expenditure on R & D) for the support of such projects. In addition, the responsibility for such projects and the budgets to fund them should be clearly identified and given to a specific department of government or government agency to administer. National scientific associations should be encouraged to submit projects for consideration with reasonable assurance of support as is the situation in the United States with the National Science Foundation.

This summarizes the general views of the physics community, and concludes my opening statement.

My colleagues and myself will be pleased to try to elaborate further on any of the points mentioned, and to attempt to answer any questions that you gentlemen may have.

The Chairman: Thank you very much.

Senator Carter: Could we hear Mr. Simmonds before we start the questions?

The Chairman: What was the idea behind your proposal that Mr. Simmonds should speak only after the discussion period?

Mr. Michael: I suggested that simply because the area on which he wanted to expound should be considered one by itself. There might be some value in discussing first the more familiar areas because they were expounded upon in the brief. However, we are entirely in your hands.

Senator Grosart: Let him wait. If he wants to have the last word, it may be a good idea.

The Chairman: Does this concern the brief entitled "Science Education in Canada" that we have?

Mr. Michael: No.

Senator Carter: Could I start off by asking each of the organizations what their membership is, and how it is divided between government, industry, and the universities?

Mr. Michael: The non-student membership of The Chemical Institute of Canada is slightly over 6,000. About 60 per cent are employed in industry, slightly more than 20 per cent in the academic community; and slightly less than 20 per cent in various types of government services.

Dr. Bachynski: I believe the membership of the Canadian Association of Physicists is something of the order of 1,400. I would estimate that about 40 per cent are in the universities; about 30 per cent in government; and the remainder in industry. It is most heavily weighted in the universities, and less in industry. We have a small student membership, but we have not been encouraging student membership in recent years.

Senator Grosart: Mr. Chairman, I would like to direct my questions, if I may, to the representatives of the Canadian Association of Physicists because this is the area in which at the moment I am most perplexed. As we came in this evening we were given two additional briefs, which I have looked over very quickly. I would like to give the Association an E for effort, because their basic document is the Science Secretariat Study Number 2 entitled "Physics in Canada", to which they refer continually throughout their brief. Then they have given us their main brief, the yellow book, dated February, 1969, and then another one dated April 1969, and then another one dated June 1969.

The Chairman: We are getting the story by instalments.

Senator Grosart: It does not matter how we get it as long as we get it, Mr. Chairman. My first question is: Why? In comparing the two documents which we have seen for the first time tonight with the ones we received previously, I do not see any great change. The basic figures and suggestions run right through. Perhaps I can start with one that I really expected to see dropped somewhere along the line. I find it in the yellow book—that is, the February submission—but I am surprised to see it is still in tonight's docu-

ment. I am not being critical, but I would like to say that this is the most extraordinary suggestion that has been put before this committee as one of the solutions to the problems of a national science policy. I think I am quoting it exactly when I say it is that there should be direct democratic representation of the Canadian Association of Physicists, or the discipline, on the Treasury Board of Canada.

Unless I am very much mistaken, the Treasury Board consists of a number of cabinet ministers. Is it your suggestion that there should be a democratic election of a cabinet minister from this particular discipline in which physicists are engaged to the Treasury Board? Is this your suggestion, or am I completely misreading the documents?

The Chairman: Do not be afraid, because Senator Grosart knows the answer.

Dr. Bachynski: Perhaps I can start off by putting the documents in perspective, and then trying to address myself to the question you have posed. The large document "Physics in Canada" is the study that we undertook for the Science Secretariat, and is or is not material to the presentation by our association to this committee. However, after having some detailed discussions with the scientific community in physics we have found that it reflects very well the views of that community two years after it was put together, and hence we chose to use it.

Senator Grosart: I agree.

Dr. Bachynski: The yellow brief is a direct representation to your committee. The green one is something which we also submitted earlier but apparently it was omitted from the original documents that you have, and, of course, the other is our opening statement today.

If I may address myself more specifically to your question, I think this is part of the problem that we have mentioned earlier of communications between the scientific societies and the government, the government and the people, and the people and the scientific societies, all in that mix. It is our feeling, from the discussions we have had with the scientific people, that most of them have the impression that something very mysterious and unknown to them goes on in Treasury Board, and yet it affects what they do, and what progress is made in their sciences, and they would like to have a better understanding of the processes that go on there, and one way of...

The Chairman: You want to go into the bedrooms of the politicians.

Senator Robichaud: Do you think that this is ever possible?

Senator Grosart: I think we should let the witness finish his statement.

The Chairman: Yes, I am sorry.

Dr. Bachynski: I think a great deal of misunderstanding arises due to the fact that the physics community is not very aware of how the decision-making processes go on, and very often the whipping boy is the Treasury Board in the final analysis. I think we would be much more assured and much more confident of the decisions that were made if we did have some indication of what the processes were.

Senator Grosart: I agree with this entirely. As a matter of fact, probably one of the major problems of this committee is to find out just why the Treasury Board seems to become the national science policy of Canada. I think we are just as much concerned about this, but it is a different thing from suggesting direct democratic representation on the Treasury Board. However, I will say no more about that. I was surprised, because my understanding was that you have a permanent office in Ottawa. Am I correct in that?

Dr. Bachynski: Yes.

The Chairman: As I understand it, you are certainly not asking to have a physicist appointed as a minister and a member of Treasury Board as such, as we know the Treasury Board here. There are officials working for these ministers, and I understand you would like to insure that there is at least a physicist among the employees of Treasury Board so that the officials of that board would be better able to give advice to the Government and to the members of the Treasury Board.

Dr. Bachynski: Yes, this is certainly one of the elements. The other is in certain cases to be able to make representations to the Treasury Board direct if the issues are significant.

The Chairman: This has never been done.

Senator Robichaud: This is against our constitution.

Senator Grosart: Mr. Chairman, you are being very helpful.

The Chairman: There is some kind of confusion here. With our new organization, I think there is certainly no objection to an association of your kind making representations to the President of the Treasury Board, Mr. Drury.

Senator Robichaud: To a minister.

The Chairman: Yes.

Senator Grosart: I was saying, Mr. Chairman, that as usual, with your very broad point of view, you are being very helpful to the witness. On page 14 of the brief we read:

...this may require some form of direct and democratic representation from the science community on Treasury Board.

I raised that question because we had the suggestion from the Macdonald study that there should be back door committee of the Treasury Board to represent those who are interested in the funding of R & D in the universities.

This does raise a very interesting question. I should like your comments on it, because you refer to the necessity of getting closer co-operation between the scientific community and the political decision-makers. We are in this committee examining the necessity for the input of science into national science policy. I think you would agree that, with the raw interpretation I have made of this, it is not practical under our system of government. Where do you see the whole science community itself developing a mechanism for the input of science into the layman's political decision, which has to be the final decision in the funding and therefore to a great extent the direction of science policy?

Dr. Bachynski: I think access to the layman is through the avenue that we mention later in our brief, in an education process to try to get some common dialogue between them. Perhaps the scientific community has been primarily at fault in this, but certainly a dialogue is required, and we are very conscious of this. I think it is in the educational process that we can do it, but it will obviously take a long time. We did make reference to the requirement for a greater scientific education for the layman and greater social education for the scientist. Some form of common ground has to be found here.

Senator Grosart: The reason I raise what I call this extraordinary suggestion of yours is because it comes out of a degree of desperation on the part of the science community.

Other claimants on public funds have found ways; labour organizations have found ways of bringing influence to bear on government policy, funding and otherwise; the Canadian Bankers' Association have representatives here; the Canadian Brewers' Association...

The Chairman: The CMA, the chambers of commerce.

Senator Grosart: Yes. The farmers of Canada may at times decide that the only way to press the Government is to have a march on Ottawa. Our problem here is the science community. Can you suggest a scientific and viable way by which the total science community can find a mechanism to insert an input of science into national science policy?

The Chairman: Senator, I think we could have general comments on this, since it is a broad question. Dr. Grace also has raised the problem of communication.

Senator Grosart: I am merely looking for an answer.

The Chairman: Would anybody else like to comment?

Mr. W. H. C. Simmonds, Director of Membership and Growth, The Chemical Institute of Canada: What we have been hoping for is some means whereby the problems of our society can be brought into balance with the resources of our society. The Economic Council has its input-output diagrams. It should be possible to construct a similar diagram showing requirements in the various areas of Canada, in the various bodies, and the resources that exist to meet those requirements. As the Chairman has pointed out in his public speeches, there should be some relationship between the research input versus the need. I think, sir, you have mentioned the case of agriculture and over-development as being a very good example where there appears to be a disequilibrium.

The way I would refer the question back to you is this. Which body in government would be competent to start balancing the economic and human requirements against the scientific and technological resources that can be brought to bear? We do not seem to have a point at which we can match these up. A lot of people conduct individual exercises in different areas, but who does the overall balancing? That will be the body to which I think we would want to report.

The Chairman: That does not really answer your question, Senator Grosart, does it?

Senator Grosart: It is very much in the area because it is really the other side of the picture. Mr. Simmonds' suggestion is that we start with the socio-economic needs of the nation and determine who should assess them and make a decision. Well, we know the answer to that; the Cabinet does it. The Cabinet does it once a year and must do it, but my question goes beyond that. I say that the Cabinet must make this decision. How are they going to get an adequate input of science into that decision? The Science Council has come up in a report, No. 4, National Priorities. A Grade 13 high school youngster could have written that. Anybody knows that when you run off transportation, urbanization and so on—This is not very helpful, because the political decision-maker is aware of these broad priorities and it is not good enough to keep saying that you must decide on national goals, because everybody knows what the national goals are. The problem is how do you fit political action into those national goals or how do you fit the two?

What I am suggesting to you is that the reason we are so delighted to have you gentlemen here and others who have come before us is that we are hoping that you, with your vast knowledge of the problems, can tell us what the answer is. There has to be a mechanism somewhere and my own view is that it must come from the science community. You must say what will make sense. We have a national science policy today. OECD tells us that we are at the bottom of the list of comparative nations and that it is out of balance, because we have an in-house surplus that does not make sense. This is the result of the science policy of Canada today, made up of a lot of ad hoc decisions all over the place. What I am asking you, as people who have thought about the problem, what can you suggest as a better way to do it instead of having all of these ad hoc suggestions. You come up and say that you should have a direct and democratic representation on the Treasury Board. I am sorry to say that I am afraid, because unless we change our whole system of Government this is impossible. It would be nice; everybody would like direct representation on the Treasury Board, such as the military, farmers, labour and the CMA. It would be wonderful, however, it would not work under our system. The Treasury Board is a political entity and unless we get some major changes it is going to be limited to the Cabinet ministers. Now, what other suggestions can you give us?

Dr. Grace: I do not have the answer, but to me there are certainly many elements. One of the elements is looking at what is going to happen and trying to assess it from as many standpoints as possible. I think we must look a lot further ahead than we are doing now and as far ahead as possible in assessing. Perhaps we should have a task force drawn from a range of people who are knowledgeable, logical and some from perhaps industry, universities and the Government. We should recruit the best people that we can find in the country in order to bring this into focus, instead of the Science Council. It is a little bit static. This would be a more dynamic group of people selected for specific areas and for specific assignments.

I admit it does not go all the way. I think there is some element of value in it.

Senator Grosart: The difficulty that I see is we have all of these now. You may change the names. We have the Science Council, Science Secretariat, NRC and if you want to go further, we have all your associations of the disciplines. We have the associations of universities and industry. We have plenty of these now, but they are not functioning and doing the job.

The Chairman: I should like to come back to the original question about communication with the Government, quite apart from the other questions you have raised before. Of course, the Science Council has a very specific function and this is to advise the Government, as we understand it now, on long-term science policies. The members of the council are there not to represent, necessarily, the scientific community, but they are there as scientists to advise the Government on science policy. We do not have the kind of representation or communication between the scientific community per se and the Government that we have in other fields, as indicated by Senator Grosart, such as the chambers of commerce and all of that. I am sure with a number of scientific organizations, associations and institutes, that it would not be feasible for the Government to admirably represent, let us say, on behalf of the scientific community, each of these organizations. We had, for instance, yesterday eight associations and groups related to the medical research profession. We had four yesterday morning related to the fields of biology, so I do not think that each individual association or council could come every year in an official capacity to make representation.

I wonder if it would not be possible for the scientific community, to decide if there would not be some kind of umbrella, such as perhaps the Royal Society or a kind of general association which would, let us say, come every year to Ottawa and make representation on behalf of the scientific community. How does this strike you?

Dr. Lynn Trainor, Member, Canadian Association of Physicists: I would like to make a couple of comments. I do not know how well I can answer your specific questions. I will say that some reference to this remark was made in our brief, democratic representation. Perhaps we were too lost in our political terms. We did use the terms representing the science community, rather than physics organizations and it was something along the lines you just mentioned.

I think the essential point we had in mind was that whatever body chosen to do this, that it will be essential that this body have the confidence of the science community.

The Chairman: These people would be chosen by the science community. They would represent the views presumably of the science community, quite apart from the work being done by the Science Council?

Dr. Trainor: Although I think it is necessary to comment that you have to be a little careful in saying representing the science community. For example, you are suggesting that the Royal Society do this. This would not be representative of the science community as it exists in Canada. The Canadian Association of Physicists are much more representative of their relative disciplines than is the Royal Society, which is a rather different structure. I am not disagreeing; one would have to do this to be certain and with care and delicacy to make sure. I think nothing destroys the science policy more quickly than the feeling among younger scientists that they are a long way removed from the solution of their problems.

The Chairman: Is that not what they have in Great Britain with the Royal Society there and in the United States with the National Academy of Science? They have these large umbrellas through which the scientific community can communicate with the public and the government.

Dr. Trainor: I suppose the traditions in different countries are different, but certainly the tradition in Canada in the physics community and in the Canadian Association of

Physicists is a very democratic one. The association was formed by young members of the community and it is very much oriented this way in the extent that I think we represent their views. One would have to emphasize this. There is a strong tradition of having the community come to decisions in a rather democratic way.

The Chairman: Do you suggest that the representations made by the Royal Society are not democratic?

Dr. Trainor: I do not know. I am not sure enough of the structure. I am not speaking as a member of the CAP, but as an individual now. I have no opportunity myself of expressing my view and I am not invited. I am not a member of the Royal Society yet. I want a voice in affairs.

The Chairman: Presumably if that Royal Society would be given that role, then they would have to consult, but what about the Institute?

Senator Grosart: The Canadian Manufacturers' Association comes before the Government regularly once a year and every brief each year starts off by saying how democratic they are, that the views they are presenting are the views of so many hundreds of individual Canadian chambers of commerce. That is the pitch they make. The Canadian Manufacturers' Association manages to make a uniform presentation, in spite of the diversity. For example, they represent importers and exporters and if any two groups had more divergent interests in Government policy than they have, I do not know who they are.

They have found it necessary to come together and I think that is what is in your mind, Mr. Chairman. It is all very well for the science community to say that they want more co-operation, that they want to be consulted more.

The more I sit here, the more I wonder if the fault is not more on the side of the science community. One of the ways to get consulted is to put your foot in the door and say you are here and that you want to be listened to. Sometimes it is necessary to do this and sometimes it is effective.

The problem we hear complained of over and over again from our witnesses from the science community is that they are not being listened to, that they have no way of getting the ear of the Government.

The way to get the ear of the Government is to decide you are going to get the ear of the Government and to come in with massive support and say you are all agreed on these things. That has not happened in the science community, yet it happens in almost every other community. Ottawa is full of lobbyists. Even the Canadian Brewers Association keeps some very capable people here full time, though I do not know what the effect is.

The Chairman: You have not given any thought to the possibility of reorganizing?

Dr. Bachynski: Could I make a couple of comments? I would agree with you that the scientists are probably the poorest lobbyists that could possibly exist. I am not convinced that lobbying is always effective, nor is it necessarily effective from the point of view of the scientific societies. One reason for this is that the payoff to whoever is going to support the scientist usually has a significant lee time and this usually means that it is downgraded in priority, so that the stick the scientist could wield in a lobbying group, per se, is not as significant as that of a group that has, say, a direct profound effect on some economic sector of the community.

Senator Grosart: I think you are downgrading immediately the importance of science. I think there is the most general recognition amongst political decision-makers of the very great importance of science in all policy, including national science policy. But the problem of the political decision-maker, as I see it, is to get some kind of, not necessarily a consensus, but certainly some kind of package. For example, in this very simple matter of the percentage of GNP, or the percentage of this year's \$11½ billion that should be devoted to research and development—OECD tells us we are at the bottom of the list. Why? Surely one of the reasons must be that the science community has not told the decision-makers that this is wrong. As a matter of fact, as far as I know, there was no knowledge of this in the science community until a completely outside organization, OECD, came along and told us that. It was not the Canadian science community that came and said we were at the bottom of the list, that we were in the lowest position in terms of the technological future of Canada and the standards of living of our people. It was an organization in Europe that had to come and tell us. This is the point I am making.

Dr. Bachynski: I was about to make a suggestion, and I think it is relevant to what

you have been saying about the scientific element in the decision-making. I was about to make the suggestion that what is required for the science community to be more closely involved in the social economic needs, and that is where their contribution to the overall requirements can then be assimilated and measured, within that framework. I think science by itself becomes very difficult to measure, as to what its contribution is, if it is isolated from the other elements in social and economic environment.

The Chairman: It seems to me, the more we listen to delegations and associations here that the science community in Canada at large is composed of very isolated sectors. There is the biologist, the chemist, the physicist. They agree that in their own professional life they and the physicists and so on have a lot of common interests but when it comes to elaborating broad guidelines for national policy there must be a kind of balance arrived at. If that kind of balance is not discussed between the sectors of the scientific community itself, and if each sector in its own isolated way comes to the Government—or not even to the Government, because they never come to the Government—but come to the different granting bodies with completely different requirements and without any kind of consensus, how can you expect that people here will arrive at the good decisions which would be good for the long-term interest of the scientific community at large and for the nation at large?

Senator Grosart: Can I state my point by saying, under the heading on page 18 of the February report of the Association of Physicists, number one recommendation is this, "that the mechanism for making science policy in Canada be clarified by the federal Government".

What I would like to see number one there is, "that the mechanism for making science policy in Canada be as follows...".

That would mean you are saying something to the political decision-makers that is helpful. To say to him that he should clarify his policy, is asking him to do the impossible because he has not the faintest idea what his policy is.

The Chairman: This is, I hope, slightly exaggerated.

Senator Grosart: It is not exaggerated a bit.

The Chairman: That politicians do not know about policy?

Senator Grosart: I am not saying that.

The Chairman: That is what you said.

Senator Grosart: I am saying the political decision-maker has not the faintest idea what the mechanism for making science policy is. He would have to sit down for four days and say, I will tell you where the NRC comes in, where the Science Secretariat and where every other department fits in. I would have to tell you where each civil servant has influence with a deputy minister and which are influenced by different science societies, which go to bed with the physicists but do not go to bed with the biologists. This would be a long story to tell you, to show the existing mechanism for making science policy. We know it is not satisfactory, because we know the result. There is a mechanism. It may be the worst mechanism in the world but there it is. That is my point.

Mr. Simmonds: Could we take your point and work it backwards. There has to be a decision at cabinet level and first of all there has to be someone in the cabinet through whom science policy is going to come. He cannot walk into the cabinet empty-handed. So behind him there has to be a group of people to assemble the relevant facts for decision-making for that particular year.

I am not naming the bodies, but I am saying that they have to be there. If you have an advisory council, the in-put will go to this particular body. If it exists, there is no question as to where we will go, because it will be the logical home for us to go to, either directly or through some other organization that might be decided upon.

Once you say that is the decision-making route, doesn't that define the type of organization required?

Senator Grosart: Not really, because the problem is twofold. A decision has to be made every year, whether it is the Arrow or ING, to give the council a certain amount of money. All these decisions have to be made as new decisions every year because of our system of annual estimates.

Now, assuming that that decision has to be made, my question is really what do you put into it; what does the science community put into it and how? The politician is dying for the answer to that. He does not want to have to say, "Well, I've got to make a decision between the demand of the medical community, the physics community, the biologists and

the sociologists"—who even now want to be called scientists just as the economists want to be called scientists.

The Chairman: I am sure that lawyers don't want that.

Senator Grosart: He does not want to have to make these decisions. He would, I am sure, welcome a mechanism by which he could say, "Well, here is a reasonable feed-in". At least he can say, here is what industry and business wants; here is what labour wants. It is fairly easy to reconcile the two. Then he has to determine what the farmers want. All right. But he is presented with a reasonable consensus of a whole community. But in science it seems to me he is presented with complete fragmentation.

For example, here is a simple question: what percentage of growth should there be in federal funding of science? Well, in this committee we have come pretty close to something reasonable. The medical research people told us about 35 per cent. Your brief said 23 per cent, I think. There is 23 per cent support of research in the physical sciences. All right. What this would do in your case would be to double the federal funding in four years. The medical formula would do it in three years. Is this right? To me this is the thing that the science community has got to sell to the political decision-maker. The pie has got to be \$2 billion instead of \$800 million. Then you can worry about carving it up. You're not going to be able to carve up the pie until there is a pie to carve.

Dr. Trainor: Senator, when we concocted this document, and it took us seven months to come up with the figures, we were under the impression that we were putting forth the recommendations of the physics community in such a form as would elicit from the Science Secretariat, to which the recommendations were submitted, some immediate action with respect to advising the Government just what the physics community wanted. We thought the Science Secretariat could act as an intermediary between us and the Government and we were willing to compromise to a certain degree. We expected to hear back from the Government immediately in a positive way. But there was no reaction at all.

Now, to be fair to the physicists, and I speak only for the physicists and not for others such as the chemists, the physics community, when it worked on this document

two years ago, had in mind that this was its answer to the needs of the physics community as those needs were seen at the time, and so they presented this document as you see it.

Senator Grosart: It is a good document, but I have a shelf of royal commission reports that have not been implemented. It just is not enough to say, "we published, therefore we are not going to perish". You can publish but still perish, when you get into the political arena.

The Chairman: May I just say that yesterday morning we were told by the representatives of the biology sector, that if the physicists were here, they would agree that biology should have the priority. This is what we were told yesterday.

Mr. Michael: Mr. Chairman, Senator Grosart has castigated the scientific community for not having an efficient lobby.

Senator Grosart: Please, I have not castigated the science community. I am with them 100 per cent.

Mr. Michael: Well, you have given the impression that they would conduct their affairs better, if they did have such an efficient and effective lobby.

Senator Grosart: "Lobby" has certain connotations I dislike, and, although I used the word once, I am sorry I did. Let us leave the word "lobby" out.

The Chairman: Representations.

Senator Grosart: Let us use the word "mechanism". We need a mechanism for the input into national science policy. Lobby has come to be a dirty word, although not necessarily so since you cannot define it. In the United States they do define it and they say that you register and it is a perfectly legitimate operation. The Minister of Finance on one occasion said to me that it is perfectly legitimate for industry and anybody affected by any legislation to make their representations known. How do we know otherwise?

The Chairman: It is an essential part of democracy.

Senator Grosart: I suggest that you don't use the word "lobby". I know I did, but I should not have in this connection, because that is not what I am talking about.

Mr. Michael: What I would like to say is that this situation, where the scientist does

not appear to have an effective voice, is one of recent growth. Until quite recently the funds available for science, while not colossal, had been more or less in keeping with the available resources at the time. It is only in comparatively recent years that the problem has come up of finding appropriate resources for the very high, in fact, sky-rocketing costs of science.

The successful scientist, with very few exceptions, by nature tends to be an introvert who worries about his work but not about the results of it. It has not, until these recent years, been forced upon him that he needs to consider amounts in a broader context. The science community, as well as the community as a whole, is still coming to grips with this problem, and, obviously, we all would not be here tonight, if there were an easy solution to it.

Senator Grosart: You have made an excellent point and I agree with it entirely.

The Chairman: I think this is the first time that particular problem has been discussed before the committee, and I think it is an important problem.

How many different organizations do we have in the scientific community, do you know?

Mr. Michael: On one occasion, Mr. Chairman, 67 bodies in the physics, life and related sciences did join to make a submission. Obviously, there are more than that, but we can say that there are at least 67.

The Chairman: That does not include the social sciences or the humanities. So it is a very difficult problem for the politician who wants to test the scientific community.

Dr. Trainor: It is also difficult for the science community and for the same reasons. Although some different sectors of science feel close together and understand one another readily, such as chemist and physicists and biologists, nevertheless, out of the 67 different groups, just to give you an example of the difficulty of communication, I probably would not even recognize some of the titles. Therefore, although I agree with both Senator Grosart and you, Mr. Chairman, that there is a need for scientists to come together, nevertheless, how to achieve a consensus among the varying branches of science is a problem with no easy solution. Certainly, it would be easier for the so-called basic sciences to come together, than for more technical sciences to come together.

The Chairman: At least if there were only two or three great organizations for this purpose that would not prevent your individual association from going on and then studying its own problem. In order to provide a more systematic channel I think that the present situation, with segmentation, is impractical.

Dr. Trainor: I think the segmentation is probably historical in the sense that most of the associations have gotten together to discuss their research findings. This has tended to draw some very sharp boundaries between even the language of communication between these groups.

Senator Carter: I wonder if the point that Dr. Michael made does not show up a weakness in the science training, where you concentrate purely on the branch of science you are interested in to the exclusion of your relationship to the world as a whole. That is a difficulty in the university. I wonder if they are thinking about this problem, because government cannot solve that; that is a problem they have got to solve. I wonder if they are giving any thought to it?

Dr. Trainor: I agree very much with your remarks, that there is a need to think about these things. I believe that in this *Canada Survey and Outlook*, which was published two years ago, the Canada Council realized that there was a need for them to broaden into more applied fields. This is not an easy task, to have a general education, because knowledge has become so specialized in the world that if you ask a young man at 23 years of age who is learning to become a physicist if he would also at the same time take time to become something of a biologist, a social scientist and so forth, this raises a problem even of years.

Senator Carter: That was not quite what I had in mind. I do not think that a person should specialize altogether in a number of branches of science. There should be some course in social science so that he can relate his specialized training in science to the social problems and keep a balance between the training he is getting in the science in its relationship to the problem. It seems to me that you become so occupied, each little branch has become so occupied with its own specialization that you think of yourselves in isolation. You do not think of yourselves in relationship to the world around you or to the problems.

Dr. Trainor: I thought it might be of interest to point out that there is some trend in the Canadian universities to this view. At the University of Toronto specifically the course in Arts and Science has been very much broadened. It is possible now for a young physicist to specialize in physics and at the same time take several courses in economics or political science. There is a much more open curriculum than there used to be in attempting to solve this problem.

Dr. Pierre Grenier, The Chemical Institute of Canada: I would like to come back to the point brought up by Senator Grosart about the difficulties in making the right decision. I think you referred to the Treasury Board, for example. It is difficult for the Treasury Board, because they have responsibility but they do not have the proper information. I would like to point out that maybe to a certain extent the scientific community feels that it has the proper information, or maybe each of these 67 bodies feel that they have the proper information, but they have no responsibility whatsoever. Maybe what you are looking for is a body with responsibility, whether it is to the house, or to people or to some other organization.

Take NRC for example; NRC is very well looked upon by the scientific community because NRC has come with the years to feel that it has a responsibility towards the scientific community. It tries very hard to look into the problems and see where the funds are needed and what are the priorities. I think the only solution is to try to set up a body which has some responsibility either to the house or to some other community.

Mr. Simmonds: Surely what you are talking about is what is known in business as the planning process, the bringing together of the various demands for money and people in various parts of the business and putting this forward for top management to examine, pointing out alternatives, if there are alternatives. The planning process is not done just on the current year; it has to be done against the future expected situation. This would require that each association in Canada submit regularly more than a brief; it would be an estimate of the forward situation in Canada. There would be one estimate required for the current year, then possibly three or four years forward. This would have to be done regularly each year. You would have one body to whom all this information is coming in, the various demands. Their job is to sort out the balance between the demands and the

available resources and to make, or to give the responsible person they respond to, some idea of the choices and allocation which exist. In this they would take into account such inputs as the Economic Council and the Science Council might bring as to the relative priorities that are foreseen in the future, both short term and long term.

In this way you have got a mechanism for balancing, what is normally called in business corporate balancing these days. This would be extremely helpful in the context you are speaking of.

Dr. Grace: I was going to come back to some very interesting points about the narrowness of scientists. Of course there are many problems in this question of how to educate a scientist today. You are shooting at a moving target; the scientist is expanding in his own field so rapidly. As has been mentioned it is necessary, certainly in industry, to interact with many other disciplines, so you want to get him to get a good grounding in one subject, a nodding acquaintance, an ability to work with other disciplines and, hopefully, have a little bit more than that. Then you have the vital problem: you want him to be a good citizen of the country. I know in my case when there was much less science known, it was a total absorption in science.

There are two other points I would like to make here: one is that education, like government or industry, is a means to an end. I think if we can focus attention a little bit more, as we have been doing to-night, on ends it is really enough. I am preparing today some very preliminary remarks for my presidential tour of the country next year. The subject that struck me as most timely is the scientist in society. What are his responsibilities? You have certainly struck a very, very important area. I think it probably will reflect over to Senator Grosart's interest. We have been totally preoccupied, or tended to be in our problems; it is very exciting, science can be extremely exciting.

The Chairman: It must remain your main job of course.

Dr. Grace: We must do a better job of striking a balance; I am sure of that.

The Chairman: We were impressed, perhaps wrongly, when we were in Washington the other day, by the fact that in the United States with a much bigger and more complex scientific community, there seemed to be a channel between the scientific community and

government through the Academy of Sciences. This seemed to be very well accepted.

As a result of the discussion tonight perhaps your respective associations and institute might have a look at how they are doing things there.

In addition to this, we had the offer of service of the Royal Society this morning, who said that if they were consulted they would see that the scientific community was thoroughly consulted on any specific subject and their advice given to us. There is that offer of the Royal Society. I do not know to what extent it is representative and to what extent it can be made more representative. There is this American experience I think should also be considered more closely.

Senator Grosart: I might add to that that we had the very definite evidence of the closest relationship between the science community and the Bureau of the Budget. They live together. From the evidence we had, the Bureau of the Budget makes no decisions without consulting the science community. Why? Because the science community is knocking at the door, they are organized, and it is a very simple thing for the Bureau of the Budget to sort out these priorities as between the different disciplines.

Mr. Chairman, this is my last question, for the moment. There is a very significant statement on page 5 of the June 5 presentation which I do not quite understand, but I am sure it is important. This is the middle paragraph:

It is, therefore, necessary that the essential role of scientific societies ...not scientific disciplines, but scientific societies...

in the development of a scientific discipline be recognized.

...with which I think we would all agree.

This can be achieved by setting aside a fraction of the national budget in a given discipline (say half of 1 per cent of the total expenditure on R&D) for the support of such projects.

I do not quite understand the language.

Senator Carter: The projects are in the preceding paragraph, I took it.

Senator Grosart: Perhaps so. Do I understand you are suggesting that there should be a specific allocation in the national R&D budget for scientific societies, as such?

Dr. Bachynski: It is not quite what was meant here. You might be able to construe it in that light, but let me go back. What we are suggesting here is that the various socio-scientific activities in this country are, by and large, neglected, and I think it is fairly evident that scientists and society, in general, do not communicate and there is not a great deal of relevance in the direction, in many cases, that each of these is going. Our association has been rather acutely aware of this problem for some time, and we have tried to do something about it. We have tried to undertake specific projects which would encompass some of this type of activity.

The big problem we have encountered is that if you are going to carry out a project you obviously need money, and the problem is to obtain funds to carry out such projects. We have been unable to find anyone who is responsible to see that projects of this nature are conducted. What we are basically saying is that there is a very great need for these kinds of projects in order to bring the sciences into perspective with society, that we should allocate some of the national resources to this, and that these resources should be given to those people who can undertake these projects. I am sure that many of the associations will be the first to knock on the door to try to contribute in this manner.

Senator Kinnear: The third concern in the February summary and report...

The Chairman: This is page 15, is it?

Senator Kinnear: Page 15, yes. There are several questions arising from that paragraph. I will read the paragraph first, so that you will have it before you:

The third concern is with the lack of opportunities in Canada for young Canadian science graduates. One might argue that lack of opportunity indicates oversupply were it not indicative of an underlying and more fundamental problem, viz. the lack of a research base in Canadian industry.

I might stop there and ask my first question. Can you do anything about the lack of a research base in Canadian industry? Do you try to encourage industry to go into research? Can anyone please answer that?

Dr. H. S. Sutherland (Past-President, Canadian Association of Physicists): Research in industry is carried out by means, usually, not of Government money, though there is some Government money in it, but by means

of gross profits. Gross profits are a function purely and simply of environmental economic climate within the country, and I think that Government can perhaps do a great deal, if they wish to encourage research, by encouraging really profitable enterprises.

I would say that successive governments—well, ever since I was a child—have done usually the reverse. In other words, the situation in the country is such that profit is a bad thing, and with regard to just about everything that a company tries to do, if it starts to make a lot of money, the money is taken away from it. I am not just talking about taxes, but a lot of other environmental factors. It seems to me that if we really want to encourage research in industry, then we should push to get Canada into an environment that would make profit a really good, fine, respectable thing; and, boy, we would hire an awful lot of physicists in Canada, I can tell you. End of speech!

Senator Kinnear: That is one way of doing it, but I think physicists or chemists could go to industry and offer their services, because industry is becoming more interested in the scientific content of their material and they are taking a new look at sales, greatly through research. I think it is not only through Government you have to do it; I would suggest your own association could be more active there.

The Chairman: I am sure Dr. Grace, for instance, since he is working in an industrial lab, will have some comments to make.

Dr. Grace: Yes, Mr. Chairman, I have two or three comments. One is that our Institute has had an employment service at virtually all our annual conferences.

Mr. Michael: And operating on a continuing basis between conferences.

Dr. Grace: And we do publish notices of openings in our publications and that sort of thing.

It is a difficult thing for an individual or even an association. Let us take an association such as ours with a mixed membership. It is difficult for us to make a drive on any major sector of our membership and to say, "You must do this," or "You ought to do that." But, of course, the group that I think we should make more use of in Canada, and of which there has been very little use made yet, is the group of industrial research managers. They are a relatively homogeneous

group. They stand as part of management; they are not generally or are not always top management in companies, but they are high enough in a company to influence company action; and I think we have made little use of them.

We had our Sheraton Park Conference last November, which was a conference of this kind. We appealed to relatively homogeneous groups—this is homogeneous in the sense of function—which stand in sight of the end product, or what is going to get into the market place. They sort of bridge the gap between university and government research and what is going to appear in the market place. This is a group of which we should make more use. They do not have all the influence with their top management. Usually it is the top management that says the budget is thus and so, and sometimes it says that the number of people you employ is thus and so, and so you get two restrictions.

So, the point I would like to make is that we should try to use the assets we have in the country, and this is a relatively untapped asset.

Do you have any comment on behalf of the CIC as to its role in this?

Mr. Michael: I would like, Mr. Chairman, to ask Senator Kinnear if she feels an association or an institute such as The Chemical Institute of Canada should approach an individual industry, or a group of industries, and say that because there are chemists available for employment in Canada those companies should employ them? Is that the tenor of your question?

Senator Kinnear: You are not supposed to ask me questions, but I shall be glad to tell you what I mean.

The Chairman: Before you do so perhaps I could ask Mr. Michael what is the situation now in the profession as to supply and demand. Is there a tendency to have an over supply of chemists.

Mr. Michael: These matters run for very short periods and in very rapidly changing cycles. It would appear at the present moment that there is a very slight overall surplus of chemists—and I repeat “very slight”. Chemistry is subdivided into so many specialties and so many sub-disciplines that there may be a slight over-supply in one and a definite deficiency in another. So, I am afraid it is very difficult to answer your question in a short but meaningful way.

Senator Kinnear: I personally feel that we have an over supply of chemical engineers. We seem to find quite a few of them looking for positions this year. I do not know whether you feel this is true.

The Chairman: Perhaps Dean Grenier can comment on this.

Dr. Grenier: For the last three years the situation has not been what it was in the years previous, but it is still very good. I have not experienced any difficulty in finding jobs for students graduating in chemical engineering.

The Chairman: I think we should allow the president of the Canadian Association of Physicists to comment also, because Senator Kinnear quoted from their memorandum in asking her question.

Mr. Michael: To amplify this I might say that one university in Canada is making very detailed surveys of the employment offers made to its chemical engineering graduates each year. I am speaking from memory, but I think that in the last three years the number of job offers per graduating chemical engineer has decreased from about 4.5 per graduate three years ago to somewhere in the region of 3.1 last year. So in that particular area and that particular university there is certainly not an over-supply, but there is an indication that the supply and demand are getting a little closer to balance.

Dr. Bachynski: Perhaps I could reply first to the question as to what is the role of the associations in trying to assist in respect of job opportunities in Canada. Our association is active in this area in a number of ways. We have a placement service. Early this year we held a meeting of corporate members. The corporate members are members of industry. We were most pleasantly surprised at the number of company vice-presidents and directors of research who appeared at that meeting, and the matters that we discussed were relevant to the question that you asked in that our discussion was directed at what is the technological position of Canadian industry.

We have also had some influence in university training. We have recommended that there should be more emphasis directed to applied physics in order to try to make the training more in tune with the times. As an association we are active in this area. We can always do more, but as an association we are doing a considerable amount in this regard.

I think the association is an almost irrelevant force in this matter. The real problem is in the technological climate in the country, and I think that in forming that climate the Government and industry are partners. I think this is where the weakness lies, particularly in the profession I represent. The technological base in Canada is very weak, and industry which is based on that has to compete against other industries in other countries. In general, the market in Canada is small, so that for an industry to be viable it has to compete in an international sphere, and that means it has to compete directly against people such as the Americans who have developed over a number of years and to a large degree through Government contracts this kind of technological base, and they have to compete also with people like the Japanese who have wage rate advantages.

I think the problem basically is one of lack of technological capability in Canadian industry, and I submit that this is a joint Government-industry problem. Those are the people who can really make some impact on it, and I think the associations can help in a peripheral sense.

Senator Kinnear: You go on in that paragraph to say:

...young Canadian scientists and engineers have to leave their homeland because of unemployment...

Now, is that increasing? I am under the impression that we are now getting a balance; that Canadians are glad to stay at home, and that Americans are coming up here; that we do not seem to have the same loss that we have had.

Dr. Bachynski: If I may comment on this from my personal experience I would say that it appears to me that there are a great many more people looking for jobs now than there ever has been. Even if one isolates this to the Canadian sector there are more young scientists looking for jobs at this time...

Senator Kinnear: In your field?

Dr. Bachynski: Yes, in my field—than there were previously. In addition, there are a number of Americans who are also trying to obtain positions in Canada. This has very significantly increased also in the last few years. but the number of applicants for a given job is far in excess of what it was several years ago. I think in industry it is far in excess of what industry is currently hiring.

Dr. Trainor: I should like to speak to this from personal experience. It is my impression that part of this situation is that a number of young scientists who would find more opportunity in their field in the United States are staying in Canada, or are happy to stay in Canada, because of a difference in political climate. Perhaps this is true more of the Americans who are coming to Canada because of the sort of human aspects of the thing. Such considerations come into it in what influences them to stay in Canada even though the opportunities are not as great as in the United States. I think this is not necessarily a reflection of a great improvement in the technological climate in Canada or a great increase in the number of industrial positions, but rather a reflection of the fact that young people will make more sacrifice in changing their field for something less than they might aspire to.

Senator Kinnear: Are we not turning out many more scientists now than we did in the past, say, five years? We have increased our scientific output in teachers and for work in industry at a much greater rate than industry itself needs. Is that not what is happening?

Dr. Bachynski: I think in terms of relative numbers this is true, but in our view the correct perspective is not the over-supplying but the lack of opportunities for these people, again looking back to the poor technological base currently existing in this field in Canada.

Senator Kinnear: Is it particular to Canada? You say there is a poor technological base. Is it that Canadian industry is not up to date enough in its research and does it not want to be?

Dr. Sutherland: The industries do not exist in many cases.

Senator Kinnear: As I say, industry has not increased enough to take more of these scientists.

Dr. Trainor: Many Canadian industries are branches of foreign, particularly American, firms, and a large American firm that has an expensive research establishment in the United States is reluctant on economic grounds to set up another research establishment in Canada. I do not want here to argue the Canadian interests; this is irrelevant. We want to keep the young people in the country and we must work harder at finding ways and means of developing research, even

though it might be counter to the continental trend.

The Chairman: Since you feel there are not enough scientists and researchers employed by industry, are you of the view that the technological gap might now be developing in Canada, compared with the United States or other countries?

Dr. Bachynski: If I might express a personal view, I think a technological gap exists.

The Chairman: Is it widening?

Dr. Bachynski: I think it probably is. It is widening in several ways, both in the particular specialty of industry and also in the breadth of industries. Many industries are based on science and technologies that just do not exist in Canada. The survey of expenditures on research in Canadian industry is very revealing; it reveals this lack of technology base in Canadian industry. This is related in many ways to the growth potential of these industries and their capability for diversification.

Perhaps I could elaborate on this for a few minutes. Basically the largest growth is in the technological type industry, for which there is either an opportunity of a lack of opportunity, depending on how well prepared you are. If you are well prepared you can then exploit the technologies. If you are not well prepared, then you dissipate all your energies trying to cope with the problems the new technologies, and more likely your competitors, are introducing.

It is my belief that the lack of a technology base in Canadian industry will hamper its future growth. The problem is the old one of the chicken and the egg, because the lack of technology bases means a large investment in order to provide them. Industry cannot really afford a large investment because the profit return is not all that good. I think it fair to say that most managements under these conditions have to take a short-term view simply because they will no longer be in the management position if they cannot show an appropriate return to their shareholders. The question is how to get the technology base started on which to build.

The Chairman: I was told by the president of an important company the other day that perhaps some of the weakness of our industrial research sector was due to the fact that the universities' approach to research and teaching was still too much in the British

tradition, that we are not really adjusted to the needs of industry.

Dr. Bachynski: Perhaps I could comment on that on the basis of experience. I am involved in an industrial research laboratory with about 45 professional people, about half of whom are Ph.Ds. The field in which we are interested is encompassed primarily by physics and electrical engineering. It has been my experience that by and large the product of a Canadian university is quite adequately trained. He is not always appropriately motivated; he may have a preoccupation with, say, purity; he feels he should make a career in pure science as opposed to applications or getting more informed in the economic aspects of it. However, by and large I have found that this problem is not a very serious one. One may run into this in specific individuals. I would also suggest that a large fraction of Canadian graduates—and these are very often the top people—do find employment in U.S. industry, and they seem to be quite adequately trained for the purpose.

The Chairman: That was not the criticism; it was not a question of training. It was more a question of motivation than training.

Dr. Bachynski: They are employed, and I know many people who have done very well in U.S. industry who have been trained in Canadian universities in the field I refer to. I think there is room for improvement, but I do not believe it to be a serious problem.

Dr. Grace: I agree that it is a matter of motivation and challenge. They have been trained by professors who have strong academic leanings, and as they take advanced training their field of specialization narrows, their interest narrows as they go deeper. I have come across Ph.Ds who have said there is no employment for them in their field of specialization in Canada. It seems rather a shame that they have been so tuned that they fear there is nothing challenging. This is not a simple problem. Industry has a responsibility, and if we are generally agreed that the use of science, the innovation, getting science into the market place, is one of our major problems, surely we need at least some of our best minds for this. How do we attract them? This is a problem between industry and the universities. One way, I think, is to try to sell the idea—and it is growing—that industrial experience, business experience, is an essential part of education, that it is not something different. This should certainly be true not

only for engineers but for scientists as well, in my view.

Dr. Grenier: The question I wish to comment on has been partly answered by Dr. Bachynski. I would say that industry is really buying technology. As was pointed out, the gap is enlarging and this may be a new form of colonialism.

Mr. Simmonds: I would like to come back to the point that Senator Carter raised about science in society. You may be interested, sir, in knowing that in Sir George Williams University Professor Knelman is giving two courses on science and society. I was invited to give corresponding lectures on engineering to the Society of Engineers.

We are, at last, beginning to bring into scientific and engineering courses the kind of university course which asks what is science and engineering for? In other words, we are trying to make them aware of the fact that science is not an isolated thing in itself. I think it is something that takes place in an activity of people and not a thing. This occurs in a society because our kind of society is interested in systematic acquisition and use of knowledge; in other words, scientists are part of the overall society. When you do this you start to get a quite different viewpoint and start to ask different questions.

On a point of clarification, Mr. Chairman, may I ask whether this committee has answered the question as to whether or not science exists for people or whether people exist to fit into science. This seems to me to be one of the basic points of any science policy.

The Chairman: I have not answered any questions yet.

Mr. Simmonds: I think the general public would very much like to have a reassurance on this subject. I do not think any authoritative body, as yet, has done this. There was an article in the *New Scientist* on May 1, 1969, which draws attention to the kind of problems that are rapidly building up in the use of computers. Human beings have what I might call an asymmetric memory. We prefer to remember the things we like and forget the things we do not like. The computers do not have this kind of memory, such as our asymmetric memories.

The Chairman: They are more rational.

Mr. Simmonds: They are, fortunately. They (the asymmetric memories of humans) make

things like families, make marriage work, make business and help the art of politics. Once you get a machine which is allowed to exert its scientific characteristics of never forgetting or of making occasional mistakes to dominate a human society you are starting to build in another destabilizing element. People do not like this kind of thing, therefore, I would suggest, as a matter of science policy, any scientific device which impinges on people should be required to have the characteristic of the society that it is working amongst and not to import its characteristics and force human beings to adapt to it. This is a pretty fundamental sort of thing and some of the legal problems here are very considerable.

Senator Grosart: Of course, the Greeks, the Romans and the Elizabethans were saying exactly the same thing as well as everybody else. This is an argument that you are just not going to get an answer to. This is why we have a political democracy, incidentally, where the people decide. However, they are still going to decide that they want fringes and colours, satellite communication and everything else. Your suggestion is that the people should be educated as to wanting only what is good for them.

Mr. Simmonds: This is a legal requirement. A computer for example has a memory that fades after so many years and people may not have access to computer memories and memories they have no right to at the moment. There is no law or pretext which prevents a person, who has a memory better than any person in this room from passing that information on to some other person. In other words, if you do not want that information passed you cannot legally prevent it.

Senator Grosart: You can very definitely. That is why we have libel and defamation laws which tell you exactly how you can pass on that information.

The Chairman: We have a hate bill before the Senate.

Senator Grosart: We do not have a law that tells you what you can retain in your memory, I do not think it is any more likely you will get a law that will tell a computer what it can retain in its memory or what a human can retain in his memory. What you cannot decide, as a matter of human rights, what use can be made of that. This is an argument that is going on at the moment as to whether the input into a computer by a credit association

should be used. Your laws of libel and laws of defamation take care of that; perhaps not adequately any more than any law takes care of any new ongoing development. We have to bring our laws up to date and no doubt we will have to bring them up to date in this respect.

The problem here is that the input into a computer by a credit association may be used to completely discredit somebody, because a neighbour happened to say they drink too much and stay up too late at night. This may be a very good reason for refusing somebody credit, taken in conjunction with some other information, but the suggestion is that it would not be the kind of information that could be relied on to convict him in court for, let us say, impaired driving. This is the point I think you are making. I think by and large that our concepts of human rights, as long as we have a political democracy, will take care of this. I believe that something of the same applies to a remark Dr. Sutherland made. I have a good deal of sympathy with this point. Obviously industry is not going to engage in research unless they can make a profit out of it. I do not quite agree with him that a Government tax of goods, say 50 per cent of the profits at the moment, is the real inhibitor; it is not any greater in our country than in the United States.

Dr. Sutherland: There are many inhibitors, not just the taxes.

Senator Grosart: This is a fact of life, that the higher the standard of living and the gross national product and gross national income in any country, the higher the total transfer payments to individuals to redistribute that income. You can go all the way up the scale from the bottom to the top.

The Chairman: It is already five minutes past 10 and we have not yet heard our last communication. I understand there is no discussion on this one, therefore, I would like to ask if Senator Kinnear has any other questions.

Senator Kinnear: No.

Senator Carter: I was just following up the point Senator Kinnear raised and which was emphasized in the brief, the lack of opportunity for our science graduates and Dr. Sutherland's reply about Canadian industry being too small to do much research. I would like to get the reaction to the idea of research institutes on campus where Government, industry

and universities can all come together so that while one industry itself may not be able to set up its own research facilities yet, a number of industries could utilize this type of facility. This would provide excellent training ground and job opportunities for science graduates. I would like to get their reaction to that idea.

Dr. Grace: In the United Kingdom, that is where many of these associations have their laboratories, sometimes they are on campus at universities and sometimes they are separate. Our own pulp and paper research institute I suppose is a pretty good example of this. In the basic ideas where there are common problems I think it works well. It varies with the particular industry, as you approach the market place and the need for differentiation, and with the need for secrecy. Of course, it does not work in those areas. It probably works more in the primary sector of industry than in the secondary sector.

The Chairman: And where the product is more homogeneous.

Dr. Grace: Yes.

The Chairman: Like the pulp and paper industry.

Senator Carter: You do not think it would lead to more innovation? You mentioned in your brief that there should be an improved economic climate, and so forth, leading to increased innovation. You do not think this would help, this kind of institute?

Dr. Grace: There are some of those institutes, as you know, in several universities. Perhaps they are not quite the type you are envisaging. They are still a little experimental.

The Chairman: The Department of Industry has started to sponsor a few of those institutes, they have four of them, but I think they are limited in scope of activity.

Senator Grosart: You also have provincial institutes and their experience of participation by industry is not very exciting.

Dr. Bachynski: This is probably a good type of institute as an intermediate stage. It has certain types of working it would be suited for and also it would be suited for very small industries who have no possibilities of doing their own research. There are problems when you get closer to the product, but it is an innovation. The problems are as to who

exploits it, what form it will take, how great the interest will be of this areas industries, and what the industries expect in return for their support of such an institute. There are many other forms which can accomplish similar things.

One is the kind mentioned by Senator Lamontagne, the chairman, which is being currently supported by the Department of Industry, Trade and Commerce. It is really a kind of institute which tries to get the university involved with industry. They go out and want to solicit problems that they can solve for industry. That is one type of vehicle. I think there are probably other types of vehicles which have not been exploited. For instance, there are Government grant schemes which give cost sharing elements between industry and Government programs.

I think it would be easy to work the universities into this, by making the terms attractive enough to industry, so that they would involve universities in this.

There are other possible mechanisms in particular programs for which grants are available only to joint proposals from universities and industry, that is, funds are available for this program if they get together and come up with a proposal, that is, a proposal which is then accepted. My own feeling is that the university and industry would probably be falling over each other trying to get together and make suitable proposals, if this kind of opportunity were available to them.

The Chairman: I presume that the contractual arrangement that Dr. Grace has suggested, after quite a number of others, including the universities, might help in this field, too.

Dr. Sutherland: A joint contract from the Government on projects which somebody might consider to be of national importance—who the somebody is, I am not quite certain, it might be you, sir—could be very good. I do not think you would need even an institute, a separate building. You could have a Government body like the NRC or some other group from the Government to tackle one phase; the university could tackle another phase; and industry could tackle the technological part of it.

In this way, one could build up a team of pretty highly skilled experts, all of whom would know each other and trust each other.

It seems to me that this kind of thing would really make science go in this country. As to who would choose the problems that is

something I am not prepared to say tonight, but I think one could dream up something.

The Chairman: We have enough problems.

Dr. Sutherland: I am sure you have.

Senator Carter: I think industry would have enough problems, especially small industry.

Dr. Sutherland: But industry's problems are proprietary problems. This was mentioned earlier. They have the problem as to who owns this, and so on. But take the national problem, such as building a national road into the Northwest Territories. I do not know whether one wants to do so or not but if they do you can obviously see that different people could take on different parts of this problems, according to their capabilities and build up this team.

Mr. Simmonds: Mr. Chairman and honourable senators, I will speak briefly as the preceding discussion has covered many points. The subject of interest was that of science in society. This is the broader one. There is the narrower picture, and you make known the fact that you can give science a social rather than a knowledge or material definition.

After thinking about this for some time, you can define science as the search for the area of widest human agreement. If you think about the way science has developed, you find this is in effect what has happened, you find the conditions in which people can agree on a certain piece of information. The importance it has is that this agreement transcends politics, ideologies, races, colours, languages, creeds and religions, and there are very few other things that do.

If you look in the world, which has many disruptive influences in it, is it correct to identify science as being one of the few influences on which people can agree? And if this statement is true, what can we do to exploit it further, under conditions where influences that bring people together across these barriers seem to be highly desirable.

This brings one to the question of who studies the impact or the relationship of technology in science on people. It is extremely difficult to get an independent or proper answer on this point.

At some risk, I have developed a triangular diagram similar to that which Senator Cameron was suggesting the other day. I do not know whether this would be of interest to

honourable senators. It shows the relationship of the major institutions in our society, and the society being broken down into three points—technological, economic, social. Perhaps I may pass this around (Document distributed).

You see two of these axes are in the area of social and in the area of economic; this is the primary area of activity of governments. Governments run on taxes and budgets and depend on votes for power.

If you look at the left hand axis, the technological-economic sector, you will see it is primarily that of business which runs on capital and is dependent on an accounting system, and its results are profit and growth.

If you look across at the bottom line, which joins technological and the social side, there seems to be a blank. We do not have a major institution operating in this area, or at least we do not seem to have one. Scientific societies seem to operate in the corner of technology, somewhat in the direction that people and provincial associations having primarily a legal basis operate on the social side with some direction towards technology.

Universities admittedly operate in all these areas, but they do not normally have power to take action. They do not have power to act.

Then we do have a number of institutions which operate in all three areas, the military-health, aerospace and underwater, which are technosocio-economic institutions, but most of us do not particularly want to live in the particular types of societies that exist in these institutions.

So I come back and ask some very simple questions, one of which might be phrased this way: if you spent very large amounts. . .

The Chairman: Churches are rather on the sideline there.

Mr. Simmonds: On this basis they are social institutions with some leanings towards economics. I hope I am not being unkind to them.

The Chairman: I am sorry to have interrupted you.

Mr. Simmonds: That is a very good point.

Now, supposing you asked the question, concerning spending very large amounts of money on science and technology or very small amounts, what effect would those policies have on major political issues such as those raised by the province of Quebec? Now, at the moment, there does not seem to be any

answer to this question. Yet, if you believe as most of us do, that science and technology represent one of the major influences and forces in society, how is it that we are unable to apply these forces to some of our major political problems? And it seems to me that it would be extremely helpful, if there could be an allocation of funds for some thorough studies in this area.

I believe this is beginning in different parts of Canada, in different universities. But however difficult the technical problems are, the real problems in our society are human, not technical. The technical are primarily the easier of the two types of problem. The human problems appear to be very considerable.

Is it not, therefore, Mr. Chairman, time that in science policy there was identified the necessity for more serious studies on this impact of technology on people and, possibly, limiting to some extent our development of just more technology for technology's sake? I merely wanted to raise that as a question.

The Chairman: Thank you very much. That reminds us, of course, as a committee, of our visit to Boston where we had the opportunity of having discussions with the Director of the Centre for Technology and Society. At the moment they are being assisted generously by grants from IBM to do an inquiry into all the impacts of technology on society, on religion, on political institutions, and so on, and they are now devoting more and more energy to the study of the impact of social technology on the individual.

We certainly thank you for having called this problem to our attention and I am sure we will leave a generous space in our report for dealing with the "institution manquante", the missing institution.

Senator Grosart: Mr. Chairman, this is just another way of saying that technology has both positive and negative values. It is the problem of society, through political and other machinery, to balance those values. Society is doing that now. If you look down through all the negative effects of technology, you will find that something very real is being done to overcome them, and one good example that comes to mind is the question of pollution.

The Chairman: Well, ladies and gentlemen, it would seem to be appropriate at this time to adjourn. Thank you very much.

The committee adjourned.

APPENDIX 113

B R I E F

Submitted to

THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

by

THE CHEMICAL INSTITUTE OF CANADA

151 Slater Street

Ottawa 4, Ontario

1.

SUMMARY

- 1.1. The development of new scientific knowledge in Canada is of national interest, particularly if it can be exploited in the country in the foreseeable future.
- 1.2 The existence of a body of highly skilled scientists is paramount to the success of such development.
- 1.3 The competency of the scientists is largely dependent on the educational institutions.
- 1.4 The productivity of the scientists is partially dependent on communication through scientific journals and scientific associations.
- 1.5 The commercial exploitation of new knowledge is largely dependent on the economic environment of the country, which is in turn related to geography, tariffs, social policy, taxation, etc.

2.

RECOMMENDATIONS

- 2.1 That the government create a National Science Foundation which would coordinate its support on all matters which would touch on the maintenance of supply and upgrading of competence of technically-trained people.

- 2.2 That the government research information services be greatly expanded to make quickly available scientific information to working scientists.
- 2.3 That the government financially support approved national scientific associations, particularly in the field of scientific publications and tours of distinguished scientific lecturers.
- 2.4 That the government consider contracting out research projects of national importance to collective groups from universities, government agencies and industry according to their abilities, thereby evolving diversified teams to better solve the nation's scientific problems.
- 2.5 That the government, as additional incentive for industrial research, include the freedom from tax of patent royalty receipts.
- 2.6 That the government consider the effect of the country's economic environment on the exploitation of new knowledge, and where possible take steps to improve this environment.

3. The Chemical Institute of Canada

- 3.1 The Chemical Institute of Canada is a national non-profit association of chemists and chemical engineers. Its charter was granted in 1945, at which time the Canadian Institute of Chemistry, the Canadian Chemical Association and the Canadian Section of the Society of Chemical Industry joined forces to form the present Institute. The present charter is based on that granted to the Canadian Institute of Chemistry in 1922.
- 3.2 Out of a gross revenue of some \$300,000, over half of which is obtained from membership fees, the Institute provides continuing services to its members and to the public through scientific and technical meetings on a local basis. To accomplish this, it has some forty local organizations in all parts of Canada. It also provides these services through eleven Subject Divisions, each operating nationally in specialized fields of chemistry, and through its constituent society, the Canadian Society for Chemical Engineering. The Institute publishes four periodicals devoted to various aspects of chemistry, chemical engineering and applied chemistry. It has recently received financial assistance from the Government (through N.R.C.) to help defray the cost of publishing one of these journals. It further serves its members and the informed public through a series of national and international

meetings and conferences. These are designed to provide forums for the interchange of views on all aspects of chemistry and chemical engineering and on the interaction of these sciences with industry, education and the community at large. The Institute cooperates with government agencies (such as N.R.C.) on projects of international nature where Canadian science is involved, and in some cases has also given financial support from its limited resources.

- 3.3 The present full membership of the Institute is approximately 6,100. In addition to this number there are enrolled some 3,200 student members, located at virtually every university and at some of the technical schools and community colleges across Canada. Nearly all of the members are or have been practising - chemists or chemical engineers, whose place of employment includes virtually all segments of the public and private sectors of the country. The majority are employed in a wide variety of process industries, with significant numbers being employed in the public service and in the academic field. A minority are self-employed or are employed by consulting firms. Members of the Institute are found at all levels of employment from laboratory bench workers and lecturers to corporation and university presidents. The members have a close common bond in that they all earn their living through chemistry and by virtue

of this have an abiding interest in the state of science in Canada. Those most particularly concerned would be that large body of members who are in government service or are in academic pursuits and whose livelihood depends wholly or partially on government funds. Any policy change from the "status quo" would undoubtedly affect their way of life for better or for worse.

- 3.4 The universality of the interests and employment of its members places the Institute in a unique position to muster talent, to give informed opinions and pass mature judgement on many subjects of national interest outside the field of pure chemistry. Certain facets of economics, international trade and education will undoubtedly have an important bearing on a meaningful science policy for Canada, and there are members of the Institute who are very knowledgeable in these subjects.

4. Objectives of a National Science Policy

- 4.1 If Canada is to have a National Science Policy, an attempt should be made to attain certain broad objectives; e.g.
- 4.1.1 The improvement of the national economy.
- 4.1.2 The establishment of national goals in the field of science.

- 4.1.3 The maintenance of Canada's stature in the scientific world.
- 4.1.4 The coordination and rationalization of the government's internal and external expenditures in the field of science.
- 4.1.5 The encouragement of the commercial exploitation of science-oriented expertise within the country.
- 4.1.6 The encouragement of the development and maintenance of a high level of scientific and technical competence among the people.
- 4.2 In order to accomplish these and other related objectives, it will be necessary to consider the policy in the light of national security, national income, international trade relations and the social objectives of the country. In fact a science policy must of necessity be a part of an overall National Policy which is determined by the national resources of all kinds available and the disposition of these resources as may be seen fit by succeeding governments.

5. Development of a National Science Policy

- 5.1 In considering the development of a National Science Policy, there appear to be three inter-related areas of importance:

- 5.1.1 The development of a new knowledge.
- 5.1.2 The exploitation of existing knowledge.
- 5.1.3 The maintenance of a highly technically competent group of people.
- 5.1.4 New knowledge achieves its greatest value only when it is exploited; and knowledge can neither be developed nor exploited without competent people. The human resource thus becomes one of the corner-stones of any meaningful science policy. The supply, quality, disposition and productivity of this resource is of major concern.
- 5.1.5 Another corner-stone is the availability and ability to attract risk capital, without which the exploitation of new knowledge will fail. It is here that Canada's economic policy will strongly influence the effectiveness of any National Science Policy which might be developed.

6. The Human Resource

- 6.1 The continuing supply of technically competent people devolves upon the educational institutions, notably the universities and technical colleges. The professors in these institutions usually play a dual role as teachers and research workers (or research directors). The research follows their individual interests and rightly so, as it keeps their teaching up to date.

It is important that the relationship between the two does not get over-balanced on the side of research to the detriment of the student.

6.2 The supply of science-oriented students entering the universities leaves much to be desired, both as to quantity and to their standards of secondary school training. This situation needs to be improved. It is recognized that this is in the sensitive area of Provincial-Federal relations, but we believe with proper support and with the help of the members of the learned societies, problems of this kind can be solved. In fact they must be solved if a National Science Policy is to be effective. It has been shown in the United States, during the past ten years, that great strides can be made in this area. Canada could well follow the example of our neighbour.

6.3 During the past quarter century the Federal Government has become increasingly involved financially in higher education, not only through a long standing post-graduate programme but also through very substantial research grants. This involvement has played a large part in providing and training the staffs (particularly on the scientific side) for the tremendously expanded university programme in the country. The economic value of the research carried out is impossible to evaluate, nevertheless it undoubtedly has

added both to the teaching potential in our universities and to Canada's stature in the world of science. The large government support to the science sector of our universities comes from a multitude of sources and in manifest in a multitude of ways. It is suggested that a National Science Policy should include the formation of a National Science Foundation which would coordinate the government's support on all matters which would touch on the maintenance of supply and upgrading of competence of technically trained people. Exhibit I, attached to this brief, a paper entitled "Science Education in Canada", submitted to the Science Council of Canada by the Chemical Institute of Canada elaborates on this subject.

- 6.4 The corps of technically competent people is found in four main areas of activity -- educational institutions; government; mission-oriented research institutes; and private industry. The prime responsibilities of each group are different although of equal importance. It is important to note that by far the greatest number of technically trained people are engaged solely in the maintenance of Canada's economy be it in agriculture, industry, commerce or medicine, without being consciously engaged in the pursuit of new knowledge. They are as equally competent in

their own fields as their teaching and research brethren are in theirs. They are inexorably entwined with the research scientist in the educational system and are the only means by which his new ideas can bear fruit. This important body of technically and scientifically trained people must be considered in any discussion of the country's human scientific resources. The problems of worth-while communication and interaction among these various groups are very great and are probably central to the inability of Canada's research effort to be properly exploited.

- 6.5 In order to provide incentive for people to engage in scientific research within the country, it is necessary for them to have an opportunity to work in a meaningful way in their fields. This will be affected by an economic climate which is largely beyond their control, but which hopefully would be conducive to the exploitation of new knowledge.

7. Communication

- 7.1 Every scientist is dependent on the knowledge developed by others, past or present. With the great proliferation of scientific information during the past quarter century, no one institution appears to be capable of collating and making quickly available this information to the working scientists. This is a national

problem and could well fall into the orbit of the National Research Council or similar government agency. The problem is an enormous one, but one which might well be another corner-stone of a National Science Policy.

7.2 The written word is by no means the only method of scientific communication. Personal contact between scientists of the same or related disciplines is equally important and in some cases more effective. A National Science Policy might envisage the contracting out by Government of large research projects which were in the national interest. Each project could be broken down, so that the work would be carried out by the universities, the government agencies, private industry and other research institutions, according to their skills and capabilities. With teams such as these working on single large projects, communication among scientists would be vastly improved and the scientific effort of the country undoubtedly enhanced.

7.3 The national scientific associations (the so-called "learned societies") of Canada play an important role in the scientific life of the country. Technical meetings at all levels encourage interaction between scientists of diversified interests. The provision of distinguished lecturers to pockets of scientific

workers remote from the metropolitan areas, keeps these groups alert to the latest advances in science. Most scientific associations publish one or more scientific journals which act as a medium of expression for the research workers, and which find their way to the libraries of the world. The cost of distribution of these journals has been sharply increased due to the new postal rates, placing an undue burden on the scientific associations. These and other activities are carried out for benefit of the members but as the tempo is increased they become of national importance. A National Science Policy should include government support of approved national scientific associations. Specifically it is suggested that this support underwrite one half of the cost of publication of approved scientific journals and the total cost of approved distinguished speakers programmes. The total cost of such support need not be enormous, and it is believed that the benefits would be great. The national scientific associations have had a demonstrably good record of usefulness to government.

8. Incentives for Industrial Research

- 8.1 The long-range attitude of private industry in the fields of research and the exploitation

of research will be determined almost exclusively by the market place. This of course will be influenced by the economic climate, the availability of capital and the social objectives of the country. There are several existing government plans designed to support industrial research and development. All play a useful part within their own limitations. The programmes appear to be effective in accelerating long-term projects which might not have been economically feasible until a later date, and also in encouraging the development and exploitation of science-based project by new companies or those with limited amounts of capital. It is believed that the various plans could be usefully coordinated and that by modification of some of the terms could be made more attractive to industry.

- 8.2 Industrial research is useful when it is successful. An existing incentive for research is the Canadian Patent Law. Weakening of this law for any reason whatsoever will have the effect of discouraging research (even government-supported research!!). A real incentive for industrial research could be the freedom from tax on all patent royalty receipts. Further, should a company exploit its own Canadian-developed patents in Canada, it should be allowed to charge

itself a proper royalty as an expense. This would cost the treasury nothing except in cases of success. It would be a powerful spur to industrial research.

- 8.3 A substantial amount of industrial research is carried out in mission-oriented research institutions. These are often cooperative ventures (e.g. The Canadian Pulp and Paper Institute) or sometimes actual branches of the government service (e.g. Mines Branch), and in a few cases within certain universities. These institutes are worthy of support either through direct grants or preferably through large research contracts on projects of national interest. By maintaining large centres of mission-oriented scientific activity there will be available inter-disciplinary pools of competent scientists who will be experts in the solution of problems which are uniquely Canadian.

9. Exploitation of Research

- 9.1 The execution of the original basic research on a project, although fundamental to the issue, is by no means the most expensive part of it. The development of the new knowledge, fresh from the laboratory bench, through pilot plants or prototypes to the point of capital investment for commercial production, is the

most time consuming, scientific manpower consuming and dollar consuming of all the processes. It is in this area that the major scientific gamble takes place. There appears to be no universally pat way of alleviating the pain. The decision to take the gamble will be influenced by the business climate of the country and whether or not the entrepreneur will have a chance to earn and retain a profit from the enterprise.

- 9.2 Canada's economic climate has been such that there has been little encouragement to exploit new knowledge. Successful exploitation must be a very selective process and the risks would appear more favourable to either exploiting well-tried (foreign) technology in Canada or alternately exploiting new Canadian technology in the larger market place abroad. Exhibit II, attached to this brief is a paper entitled "Economic Development and the Government - Industry Interface", which was presented to the Chemical Economics Division of the Chemical Institute of Canada and which elaborates on the problem of building new chemical plants in Canada.

10. Conclusion

The ingredients of a healthy scientific life in Canada are a highly-competent people, a

means of communication and a means of exploitation of scientific effort. The competency of the people must be assured by the educational institutions, the means of communication through the scientific journals and the scientific associations and the exploitation of scientific effort by the economic climate, which is a reflection of the government's policies.

ANNEX A

SCIENCE EDUCATION FOR CANADA

We live in an age of science and technology in which no nation can hope to achieve or maintain a position of leadership without the fullest development of its scientific potential. To fully realize this potential, we must (1) make certain that those who are scientifically trained are given the opportunity of putting their training to work, and (2) do whatever may be necessary to assure an adequate supply of well trained scientific workers. It is quite evident that the problems inherent in these two concepts are of such a magnitude as to warrant the fullest attention of all sectors of society -- schools, universities, industry, provincial governments and the federal government.

In developing a national science policy and program care must be taken to ensure that education in the Fine Arts, Humanities and Social Sciences is also adequately supported.

It takes from 20 to 25 years of study to become a reasonably proficient scientist. No amount of money for the support of research can materially shorten this time, nor can large sums of money for the support of research be used efficiently unless there are well trained scientists to do the work. We may easily lose sight of the fact that the support of research is really the support of competent investigators, without whom there is no research. It is also easy to lose sight of the fact that the training of a scientist does not begin with research, but at a much earlier stage of the student's education, the research training coming at the end of a long educational process. Improvements in scientific education therefore involve all levels of the process. The best scientific education involves not only time but able students, skilled and dedicated teachers, the best and most modern materials with which to teach, and

learning opportunities for the gifted student beyond those found in the usual classroom courses.

The foregoing raises a number of problems which must be successfully attacked if we are to achieve significant improvements in science education. These problems are:

1. The need to improve the competence of teachers of science and mathematics at all levels of education.
2. The need for thoroughly modern materials of instruction and courses of study.
3. The need to provide specialized kinds of experiences for able secondary school and university students.
4. The need to provide support which will enable talented science graduate students and established scientists to obtain the finest advanced training possible.
5. The need to provide the specialized facilities and equipment which are peculiarly necessary to scientific study.
6. The need to provide the public with an understanding of science and an appreciation of the need of support for scientific education.

Since 1916 the National Research Council of Canada has been providing increasing financial support for research in the science and engineering departments of Canadian universities through scholarship and grant-in-aid programs. The need for greatly increasing the magnitude of this support has been clearly stated in the "Forecast of Needed Federal Support of Research in the Natural Sciences and Engineering in Canadian Universities, 1964-1969" as prepared by a special forecasting committee of the Honorary Advisory Council for Scientific and Industrial Research.

If it is assumed that greatly increased Federal support for scientific research will be forthcoming through the National Research Council, we are still left with the problem of providing for the primary needs of science education as

enumerated under points 1, 2, 3, and 6 above. Some national body (National Science Foundation) should be created in Canada to mount a concerted attack on these problems at the earliest possible time, otherwise we may find ourselves with adequate funds and facilities for research and an inadequate supply of on-coming scientists.

The necessity of providing extensive support programs for science education at all levels was recognized by the Government of the United States over a decade ago when the National Science Foundation of that country was created. An outline of the programs of that Foundation is given in the appendix to this brief. It will be noted that many of the NSF programs are similar to National Research Council of Canada programs, especially the graduate fellowship and grants-in-aid of University research programs. However, there is no agency in Canada which directs its efforts towards and provides financial support for the whole spectrum of science education.

The efforts of the American NSF to improve science education and curricula at all levels of education in the United States are exerting a strong influence in Canada, especially in the area of high school curricula. For example, the province of Saskatchewan is introducing PSSC physics, CHEM Study and BSCS biology courses in its high school system as fast as teachers can be trained to handle the new approaches to science teaching. Education authorities in several other provinces of Canada are planning similar curricula changes in their high school science courses. Unfortunately, extensive financial support for science teachers' institutes is not generally available to Canadian Universities.

There is a critical shortage of well trained elementary and secondary school science and mathematics teachers in all provinces of Canada. This situation cannot be allowed to continue indefinitely or the quality of our science education

will deteriorate very rapidly and we will face an acute decline in the supply of scientists, mathematicians and engineers. In fact, there is ample evidence indicating that we are now failing to produce enough honours graduates in these areas to adequately supply candidates for the graduate schools that we presently have. This may well be attributed to our failure to provide a sufficient number of properly qualified elementary and secondary teachers of science and mathematics.

A number of Canadian high school teachers have attended NSF supported Summer Institutes in the United States. They have been very impressed with the type of program offered in these institutes and wonder why we do not have financial support for such programs in Canada. They have all benefited greatly from association with their contemporaries from all parts of America. Many of these teachers are now showing leadership in the revision of out-dated and inadequate science curricula in our Canadian school systems. Encouragement by way of financial assistance for the training of teachers of science and mathematics is sadly lacking in Canada.

Canadians can derive little satisfaction from the fact that we depend on our southern neighbour to provide us with up-to-date science courses and materials and some help in training our teachers. We should be doing much more towards developing new science courses for ourselves and in providing opportunities for our science teachers to enhance their knowledge and teaching competence.

The members of national professional and scientific societies such as the Royal Society of Canada, the Engineering Institute of Canada, the Canadian Medical Association, the Canadian Association of Physicists, and The Chemical Institute of Canada, have frequently discussed some of the problems involved in improving and supporting science education in Canada. Canadian scientists and engineers generally realize that there is a pressing need for the development of

a science policy that will result in broad provincial and federal aid to meet the requirements of science education now and in the future.

Summary

While the Government of Canada does provide financial assistance for higher education through federal grants to Canadian Universities, and the National Research Council of Canada does provide an increasing measure of support for scientific research and for the support of graduate students in Canadian Universities, the program is still far from adequate to meet all of the needs of science education. A national science policy which will result in the provision of substantial financial aid being made available to meet all the needs of science education including the training of science and mathematics teachers at all levels of education, and the support of studies directed towards the improvement of science education, should be developed.

RECOMMENDATIONS:

It is recommended by the Board of Directors of the Chemical Institute of Canada that:

- (a) the concern of The Institute regarding the lack of adequate financial support for the comprehensive development of our science potential be conveyed to the Government of Canada through the Science Council of Canada.
- (b) the Government of Canada be urged to formulate in cooperation with the Provincial Governments a national science policy that will result in the provision of adequate financial support to meet the needs of science education as outlined in points 1 to 6 of the foregoing brief, and that the Council of Ministers of Education of Canada be urged to support such action.
- (c) other professional scientific societies of Canada be urged to support the above proposals.
- (d) the Canadian Education Association and the Association of Universities and Colleges of Canada be asked to support these proposals.

APPENDIX A

THE NATIONAL SCIENCE FOUNDATION OF THE UNITED STATES

In 1950 the Federal Government of the United States through its National Science Foundation Act set up an organization --
" -- to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences;

-- to initiate and support ... programs to strengthen scientific research potential in the mathematical, physical, medical, biological, engineering, and other sciences,

-- to maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel"

This organization has been established in the executive branch of the government as an independent agency. Its affairs are directed by a board of twenty-four members appointed by the President, by and with the consent of the Senate. The persons nominated for appointment as board members are:

- (1) persons eminent in the fields of the basic sciences, medical science, engineering, agriculture, education or public affairs;
- (2) selected solely on the basis of established records of distinguished service;
- (3) selected so as to provide representation of the views of scientific leaders in all areas of the nation.

The President is requested, in the making of nominations of persons for appointment as board members, to give due consideration to any recommendations which may be submitted to them by the National Academy of Sciences, the Association of Land Grant Colleges and Universities, the National Association of State Universities, the Association of American Colleges, or by other scientific or educational organizations.

PROGRAM OF U.S. NATIONAL SCIENCE FOUNDATION

The U.S. National Science Foundation's programs in science education are developed and carried out by the Division of Scientific Personnel and Education, and are conducted within the following organizational structure: *

THE FELLOWSHIP SECTION - responsible for administration of programs of support to graduate students, teachers, and advanced scholars in science, mathematics, and engineering according to plans designed to meet the educational needs of individuals.

THE INSTITUTES SECTION - responsible for administration of programs of group study, primarily for teachers of science, mathematics, and engineering, directed towards the improvement of science education.

THE SPECIAL PROJECTS IN SCIENCE EDUCATION SECTION - responsible for experimental testing and development of promising new ideas for: (1) improving instruction in science, mathematics and engineering, and (2) increasing the understanding of science, mathematics, and engineering on the part of young people.

THE COURSE CONTENT IMPROVEMENT SECTION - responsible for support of projects designed to: (1) produce up-to-date course-content materials for instruction in science, mathematics and engineering; and (2) promote the development of supplementary training aids to increase the effectiveness of teaching in these fields.

THE SCIENTIFIC PERSONNEL AND EDUCATION STUDIES SECTION - responsible for the administration of the National Register of Scientific and Technical Personnel and for the collection, evaluation, and dissemination of information about scientific and technical personnel.

A brief description of the programs carried on under these sections is as follows:

THE FELLOWSHIP PROGRAM

The programs offer a wide range of training opportunities for graduate students, secondary school and college teachers of science, and advanced scholars. Fellows in each of the following categories are selected on the basis of ability by the N.S.F.

1. Graduate Fellowships for students studying for a post graduate degree in science, mathematics or engineering.
2. Cooperative Graduate Fellowships similar to graduate fellowships, except that individuals apply through and are initially evaluated by the U.S. participating institutions which they expect to attend as fellows.
3. Summer Fellowships for Graduate Teaching Assistants for support of summer study by graduate teaching assistants.
4. Postdoctoral Fellowships primarily for individuals who have recently received a doctoral degree in science, mathematics, or engineering.
5. Senior Postdoctoral Fellowships primarily intended for recognized senior scientists, mathematicians, and engineers.
6. Science Faculty Fellowships for junior college, college, and university teachers of science, mathematics, and engineering.
7. Summer Fellowships for Secondary School Teachers for the support of graduate study by secondary school teachers of science and mathematics.
8. Senior Foreign Scientist Fellowships for nationals of foreign countries to engage in appropriate scientific programs at participating U.S. universities.

* Information presented has been abstracted from "Programs for Education in the Sciences" NSF-63-20.

A total of 5,089 fellowships were awarded under this program in 1963.

INSTITUTE PROGRAMS

The foundation's institute programs are designed to make it possible for in-service teachers in elementary schools, secondary schools, and colleges to obtain additional instruction and become acquainted with new developments in science and mathematics. The following kinds of programs have been supported:

1. Summer Institutes for Secondary School and College Teachers of Science, Mathematics and Engineering

This program has grown from support of two institutes in 1953 to support of 484 institutes in 1963. The number of teacher-participants and duration of summer institutes vary considerably, but 50 participants and 7 weeks are average. An institute may concentrate its offerings in a single area (e.g. biology) or offer work in several areas (e.g. chemistry, physics and mathematics). These institutes are characterized by offering subject-matter courses designed especially for the teachers who attend. The maximum award to a participant is \$75 per week for stipend, \$15 a week for each dependent up to a maximum of four, and travel allowance for a single round trip from home to institute to a maximum of \$80.

2. Summer Institutes for Elementary School Personnel

These institutes are similar to those for secondary school teachers, differing from the latter only in that they are designed to meet the specific needs of elementary school personnel. During 1963, 33 institutes of this type received N.S.F. support.

3. Conferences for College Teachers

These are conferences of short duration (1 to 4 weeks) devoted to the consideration of specialized topics or recent advances in a particular area of science, mathematics or engineering. Some 30 to 40 such conferences are supported annually. Participants receive full living and travel expenses and the participating institution receives a grant to pay direct costs for organizing and staffing the conferences.

4. Academic Year Institutes

Grants were awarded to 58 institutes for the academic year 1963-64 and approximately 1,750 secondary school teachers and 110 college teachers participated. The courses in academic year institutes are based on the subject matter of science and mathematics. In many instances they enable secondary school teachers to earn graduate degrees at the Masters level. Maximum stipends are \$3,000 per academic year.

5. In-Service Institutes for Secondary School Teachers

In-service institutes are especially designed to meet the needs of secondary school teachers of science and mathematics for supplemental instruction in science or mathematics through courses offered on Saturdays or during after-school hours. They are conducted by colleges and universities with the aid of N.S.F. grants.

Funds in support of 284 in-service institutes for 13,770 secondary school science teachers were granted in 1962-63. Similar programs are provided for elementary school personnel.

SPECIAL PROJECTS IN SCIENCE EDUCATION

This section is concerned principally with the development and testing of promising new ideas for the improvement of science instruction. Many of the activities are research studies, designed to answer the question, "How can we improve science education?"

The following programs have received N.S.F. support:

1. Summer Science Training for Secondary School Students with the object of encouraging high-ability secondary school students to pursue their scientific interests in specially designed summer programs where they have the opportunity of working with experienced scientific investigators.
2. Cooperative College-School Science, programs in which institutions of higher learning and non-profit research organizations receive support for carrying out collaborative efforts with secondary schools to improve secondary school offerings in science and mathematics.
3. State Academies of Science receive support for programs designed to improve the status of science and science education in the State.
4. Holiday Science Lectures. A series of lectures by a distinguished scientist is arranged for selected audiences of scientifically talented students during the winter and spring holidays. Students have the opportunity of meeting the scientist.
5. Visiting Scientists (Secondary Schools). Prominent scientists and engineers visit secondary schools to make personal contacts with students and teachers and offer counsel concerning careers in science. This is usually done in cooperation with one of the professional societies.
6. Research Participation for College and High School Teachers. Through participation in laboratory research programs at colleges and universities during the summer, science and mathematics teachers in high schools and small colleges are offered an opportunity of enhancing their professional backgrounds and teaching competency. Support for stipends and travel for the teacher participant is provided.
7. Supplementary Training for Science Teachers. A wide variety of experimental projects designed to improve the subject-matter background and effectiveness of teachers who have already attended institutes, received fellowships or taken part in research programs, e.g. through specialized short conferences at universities or special work conferences to focus attention on some specific educational program.
8. Visiting Scientists (Foreign). Distinguished foreign scientists are brought to the country for periods of from 3 weeks to a full semester. The scientist is usually attached to some university which serves as a base from which visits to other educational institutions are made.

9. Undergraduate Research Participation and Independent Study. The program supports activities carried out by colleges, universities, and non-profit research institutions to enable superior undergraduate students of science and engineering to participate in research or independent study beyond the level normally available to undergraduates.

10. Undergraduate Instructional Scientific Equipment. Grants are made on a matching-fund basis to colleges and universities to assist them in the purchase of equipment which will significantly improve science instruction at the undergraduate level.

11. Advanced Science Seminars. Seminars for specialists in a particular field or field in which the subject matter commonly transcends the limits of the usual departmental offerings are supported.

12. Public Understanding of Science. The aim of this program is to provide the public with more and better information about the nature of science and its relationship to daily life.

COURSE CONTENT IMPROVEMENT PROGRAMS

Curricula and courses in mathematics and science in elementary and secondary schools--often in universities also--have, until recently, failed to evolve at a pace commensurate with the rapid growth of scientific and technological knowledge. In part the lag has been due to the volume of new knowledge and the accelerating pace of discovery in science. To some extent it is also attributable to the gulf which has developed between research scientists primarily concerned with the acquisition of new knowledge and teachers, writers, school administrators, and others primarily concerned with the diffusion of knowledge. Some consequences of this general situation are:

- (1) a low level of scientific literacy among citizens at a time when the public is increasingly confronted with a need for scientific knowledge,
- (2) the loss of many potential scientists, mathematicians and engineers and
- (3) a serious waste of time in the preparation of those students who do pursue science courses in universities.

Scientists, mathematicians and engineers in the United States have recently begun to give increasing attention to their responsibility in the development of improved instructional programs in science and mathematics in their schools and universities. Through their efforts contemporary knowledge and points of view are being reflected in new course materials. Attention is also being directed towards curricula designed to help present and prospective teacher improve their competence in teaching the new approaches. Many scientists and teachers are becoming increasingly aware of the need for new supplementary teaching aids such as films, laboratory equipment and up-to-date libraries. To help support these essential activities, the N.S.F. has developed two programs:

- (1) Course Content Studies and Development and
- (2) Supplementary Teaching Aids

The programs are carried out by highly qualified scholars under the aegis of universities, professional scientific organizations, or non-profit educational organizations.

I Course Content Studies and Development

The Foundation is committed to the belief that for elementary and secondary schools the primary responsibility for curriculum improvement rests with the States and communities. For colleges and universities, curriculum improvement is also a matter for which each institution considers itself responsible. The intent of the Foundation's programs has been to focus the best talents of the Nation on the development of generally acceptable ideas for the improvement of instruction in mathematics, science, and engineering, as well as the production of materials useful to all schools and colleges.

Under this program, major emphasis was initially placed on secondary school courses. Large scale projects which have received substantial N.S.F. support include:

1. The School Mathematics Study Group
2. The University of Illinois Committee on School Mathematics
3. The Physical Science Study Committee
4. The Chemical Bond Approach Project
5. The Chemical Education Material Study
6. The Biological Sciences Curriculum Study

Projects designed to improve college and university instruction are also receiving financial support. These include:

1. Committee of the Undergraduate Program in Mathematics
2. Commission on College Physics
3. Advisory Council on College Chemistry
4. Geological Education Orientation Study
5. Commission on Engineering Education

II Supplementary Teaching Aids

Films and television can enrich instruction in many respects--for example, an outstanding teacher can reach many more students by this means; laboratory and field observations to which few students might normally have access can be brought into the classroom. The program in this area provides support for the development of high-quality presentations by very able scientists, assisted by teachers and professional producers of television films and tapes, under the sponsorship of colleges, universities, and scientific societies. There is also a generally recognized need for the development of new equipment for demonstration purposes and laboratory instruction. Consequently, the N.S.F. supports efforts of scientists and teachers in the design and development of prototypes of new instructional equipment for use in science and engineering courses in elementary schools, high schools, colleges and universities.

A detailed description of N.S.F. Course Content Improvement Projects is given in N.S.F. publications --

"Science Course Improvement Projects - 1" which deals with courses, written materials, films and studies, and

"Science Course Improvement Projects - 2" which deals with projects concerned with the design of new teaching equipment.

SCIENTIFIC PERSONNEL AND EDUCATION STUDIES PROGRAMS

1. The National Register of Scientific and Technical Personnel

A comprehensive program for registration of U.S. scientists is maintained so that timely information on the supply and professional characteristics of qualified personnel in important science fields will be readily available when needed for important assignments in the national interest.

2. Scientific Manpower Studies

The N.S.F. supports projects which include the compilation and analysis of information on the demand for and the supply, characteristics, utilization, and training of scientific and technical personnel, and the provision for the dissemination of such information in the most useful forms for program and planning guidance. The program is directed toward meeting the scientific manpower needs of government agencies, private organizations, and the public generally.

COST OF N.S.F. SUPPORT PROGRAMS

The magnitude of the financial support provided by the N.S.F. for the various types of programs in the fiscal year 1963 is indicated in the following summary:

Basic research project support

| | | |
|---|------------------|-------------|
| Biological and medical sciences | \$38,394,851 | |
| Mathematical, physical & engineering sciences | 59,895,475 | |
| Social sciences | <u>8,956,172</u> | |
| Subtotal | | 107,246,498 |

Development & improvement of institutional science programs

| | | |
|--|-------------------|------------|
| Institutional base grants | 7,601,685 | |
| Instructional equipment for undergrad. educ. | 7,734,063 | |
| Undergrad. & graduate science facilities | <u>28,993,638</u> | |
| Subtotal | | 44,329,386 |

Special research facilities support

| | | |
|--|----------------|------------|
| Specialized biological facilities | 3,499,480 | |
| Specialized social science facilities | 159,550 | |
| University computing facilities | 4,980,000 | |
| University nuclear research facilities | 8,500,000 | |
| Oceanographic research vessels & equip. | 5,913,200 | |
| University atmospheric research facilities | <u>750,000</u> | |
| Subtotal | | 23,802,230 |

National Research Centers

| | | |
|----------|--|------------|
| Subtotal | | 14,480,000 |
|----------|--|------------|

National Research Programs

| | |
|----------|------------|
| Subtotal | 17,077,682 |
|----------|------------|

Special Information Services

| | |
|----------|------------|
| Subtotal | 10,325,766 |
|----------|------------|

Science Education Programs

| | |
|---|-------------------|
| Fellowships | 21,678,136 |
| Institutes | 41,804,084 |
| Research participation for teachers | 2,559,079 |
| Science educ. for undergraduates | 5,878,348 |
| Science educ. for secondary school students | 3,682,732 |
| Specialized advanced science educ. projects | 2,752,589 |
| Course content improvement | <u>12,632,408</u> |
| Subtotal | 90,987,376 |

Science Resources Planning

| | |
|----------|-----------|
| Subtotal | 1,616,332 |
|----------|-----------|

Program development and management

| |
|-------------------|
| <u>10,865,568</u> |
|-------------------|

| | |
|-------------------|---------------|
| Total expenditure | \$320,730,838 |
|-------------------|---------------|

APPENDIX 114



CANADIAN ASSOCIATION OF PHYSICISTS

ASSOCIATION CANADIENNE DES PHYSICIENS

BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE OF THE SENATE
ON
SCIENCE POLICY

FEBRUARY 1969

Special Committee

CAP - ACP

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS

Brief Submitted to

THE SPECIAL COMMITTEE OF THE SENATE

on

SCIENCE POLICY

February, 1969

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I. Summary

1. Physics is the branch of knowledge concerned with the discovery and elucidation of those natural laws which determine the nature of our physical environment. As such, it underlies all other branches of physical science and much of engineering. To study physics is to satisfy man's natural curiosity concerning the world about him; it is an essential part of our heritage and our culture. But in the world of today, it is much more; it is an essential component in the structure and development of the technological society, and hence in the social and physical well-being of its citizenry.

2. The Canadian Association of Physicists is a national organization whose aim is to promote physics in Canada. It is the only such professional organization and over half of the known physicists in Canada are members. Membership on January 1, 1969 was 1,400 physicists with professional qualifications. The Association is an active one and has produced in recent years a number of widely read and significant documents bearing on science policy. Some of these are listed in Appendix A.

3. The Canadian Association of Physicists initiated in 1966 and carried out in 1967 a special survey of physics in Canada under contract with the Science Secretariat. The CAP Survey¹ gave a careful analysis of the situation in

Canadian physics at that time and made many specific and detailed recommendations to the federal government concerning the support of scientific research in Canada. These recommendations are as valid today as they were two years ago and the CAP Survey which incorporates them still represents the thinking in the physics community rather accurately.

4. In the intervening two years there has developed an increasing concern with the question of national science policy and the economic and cultural independence and well-being of the Canadian nation. We believe that the process of developing a national science policy must be a continuing one, for circumstances change and it is easy for bureaucratic and inflexible structures to get out of tune with the times. A science policy which does not have the confidence of both the public and the science community is not likely to be either imaginative or successful. It is particularly important, therefore, to set up effective machinery for communication between scientists, the public and government policy makers. On the general question of evolving a national science policy we are particularly concerned with the economic, social and culture needs of this nation. In the main, this concern re-emphasizes those recommendations of the CAP Survey which have to do with the development of applied physics research in Canadian industry and with the rational development of Canada's national resources.

5. Although it was not emphasized in the CAP Survey, we believe the question of a physics education is a very essential one. The discipline of physics plays a very central role in the scientific society, particularly with regard to technological innovation and industrial development in science-based industries. Hence, it is important in the training of supervisory and managerial personnel in these industries to put greater emphasis on physics education and research experience in pure and applied physics.
6. This brief will introduce and elaborate the following three recommendations:
- (1) that in developing a national science policy the need for effective communication between scientists, government and the public be given the highest priority;
 - (2) that in consideration of its social, economic and cultural benefits, physics research in Canada should be supported in accordance with the general recommendations of the CAP Physics Survey¹ (see Appendices B, C and D);
 - (3) that emphasis be given in educational institutions and in government and industrial organizations to the value of a physics training for the non-specialists, particularly those who eventually become concerned with innovation, production and marketing in the science-based industries.

II. Canadian Association of Physicists -
Association Canadienne des Physiciens

7. The Canadian Association of Physicists is pleased to have this opportunity of presenting a brief to the Special Committee of the Senate on Science Policy. We have followed the proceedings of the Committee with a great deal of interest; certainly we regard this kind of dialogue between a political arm of the government and members of the science community as extremely valuable, quite aside from the specific intention of the Committee to prepare a report on its findings. Despite the fact that we live in a veritable sea of communication media, we are aware that the degree of specialization in a modern technical and industrial society makes effective communication more difficult. Dialogue does not always "just happen" -- it has to be promoted. We hope the Canadian Government will strengthen the trend that has developed in recent years for the scientific and the political communities to recognize their interdependence and their mutual obligation to the general public.

8. The Canadian Association of Physicists is a national organization whose aims are:

- (a) to further advance the science of physics;
- (b) to promote the use of physical discoveries in the interests of mankind;

- (c) to promote knowledge in the physical sciences and the dissemination of information relating thereto in and between all sections of Canada;
- (d) to advance mutual understanding and cooperation between physicists on the one hand and universities, research organizations, and industry, on the other.

It is the only professional organization of physicists in Canada. Its active full membership of 1,400 includes most of the prominent physicists in Canada and fully half of all Canadians who identify themselves as physicists belong to the organization. The officers of the Association are listed in Appendix A; also Appendix A summarizes many of the current activities of the organization.

9. The Association is an active organization which in recent years has produced several widely read and significant documents as aids to those responsible for establishing policies for the support of Canadian science. Three of these documents (references 1,2 and 3) are immediately relevant to the substance of the present brief.

III. Physics and Society

10. Dr. Solandt has already expressed very forcefully to the Senate Committee on Science Policy⁴ three main reasons why the public should support scientific research, viz. the cultural reason, the social reason and the economic reason. We agree with this general assessment and would like to explain why we think this is particularly so of physics research.
11. We consider first the cultural reason. Physics is the modern outgrowth of what used to be called natural philosophy and it has played for many centuries an important part in the growth and development of western culture. To omit the study of physics would be to cut off our curiosity about ourselves and our natural environment. The study of physics has had profound effects on the development of western philosophy, and it underlies in large measure the whole structure of twentieth century technology.
12. We would like to stress two distinct but intimately related aspects of physics as part of our culture, namely, the educational and the research aspects. To teach physics to young people is to open doors of understanding to them about the nature of their universe; this understanding not only satisfies their natural

curiosity, it equips them in an essential way to deal with the problems and challenges which they must face in a world of rapid technological change. In the broad sense, a better understanding will require improved science teaching in the schools and universities, and more and better exposure to science via the communications media; it will also require a greater degree of social commitment on the part of the scientist.

13. But education itself is not enough. It is not sufficient to learn and appreciate what is known; the human instinct is to ask new questions, to seek new answers. A static culture is a mere curiosity piece; in an expanding culture research is an integral part of the social dynamic and the social creativity.

14. We turn now to the social reason why physics research should be supported by the public. Whether we like it or not we are caught up in the technological maelstrom; we share the benefits and face the concerns of this scientific age -- the clock cannot be turned back. It seems to us essential that scientists be brought into the social and political milieu so that they can bring their expertise and their knowledge, their special techniques and devices, to bear on the important social and economic problems facing our society. An intelligent and enlightened science community is an asset which cannot be willed into existence at the social desire and dispatched again. This asset is

like a plant -- it requires steady nurture over long periods of time if it is to reach maturity and be productive.

15. Finally, we come to the economic reasons for supporting physics research. Physics is that branch of human knowledge upon which all of the physical sciences and most of engineering is based. It is the forefront of knowledge and, as it pushes its frontiers further into the unknown, it casts off its established aspects thereby creating new branches of science and engineering. To cite but one example, the entire field of electrical engineering with all of its associated industries developed out of physics, and in fact, was at the frontier of man's knowledge only a century ago. For a long time physics was largely confined to interpretations of those natural phenomena which man could detect and measure with his own senses. This led to the well-known branches of physics which have come to be called "classical physics": mechanics, optics, heat and sound, each of which is still treated as a separate subject in elementary text books on physics. At the turn of the century the first of the elementary particles of matter, the electron, was discovered and a whole new era of physics began. Atomic physics, nuclear physics, solid state physics, plasma physics, and high energy physics, to mention only the better known fields, are parts of what is now called modern physics. Just as the various branches of classical physics lead to the optical industry, the electrical

industry and much of the transportation industry, so has modern physics given rise to technical developments of immense economic importance: the communications industry, the computing industry, the nuclear power industry, to mention a few.

16. Much of the exciting work in modern chemistry, medicine and biology is based on the principles of atomic and molecular physics, and is made possible by measuring instruments and techniques conceived and developed by atomic and molecular physicists.
17. The process of evolution of ideas and techniques from fundamental research in physics to social practice and industrial application is a continuing one. It is, of course, true that new technology feeds back and has a profound influence on basic research methods themselves, so that the interplay between basic and applied physics becomes important and fundamental. The question of which came first, basic research or technology, is something like the chicken and the egg -- both evolve together. New discoveries in basic physics provide great stimulus for new technologies, but the new technologies themselves lead to yet new scientific discoveries.
18. The National Inventors Council of the U.S.A. (which advises the Secretary of Commerce on policies relating to inventions) recently attempted to identify the top ten

outstanding technological inventions of the past twenty years⁵. Among the contenders for inclusion were the transistor, the laser, holography, integrated circuits, colour television, fibre optics, and various types of satellites and rockets, all depending heavily upon fundamental physics research at some stage for their inception and development.

19. However, though physicists probably generate the new ideas and principles behind more products than do any other type of scientists, they are themselves only a small part of the total group extensively involved in a professional way in the long process of developing a research discovery into a marketable product. The talents and skills involved in this long chain are many and are provided in varying degrees by applied scientists, development engineers, mechanical and production engineers, sales personnel, economists, lawyers, managerial staff, etc.

20. Physics should, however, be involved in this process in three separately identifiable ways: pure research at the inception of the process, applied physics during the development stage, and a knowledge of physics at all stages including production and marketing and acceptance by the public of the final product. The importance of an awareness of physics, in fact of science generally, by all concerned in the long chain of modern industrial operations has been emphasized recently. It was

forcefully brought to light by the Organization for Economic Cooperation and Development in its analysis of the Technological Gap between America and the rest of the world.⁶ This analysis highlighted the need for a scientific influence in the training of the non-scientists, especially the managerial classes, involved in the industrial hierarchy.

IV. Status of Physics in Canada

21. At its annual meeting in June, 1966, the membership of CAP authorized its Executive to approach the Science Secretariat and to negotiate a contract with Secretariat to carry out a study on the status of physics in Canada. A steering committee was set up under the chairmanship of Dr. D. C. Rose and twelve subdivision committees were established to assess the various subfields of physics, such as astronomy, nuclear physics and biophysics. The entire physics community responded magnificently to a plea for cooperation and the data was assembled during the fall of 1966. In the first four months of 1967 the subdivision reports were written, and the whole document put together and published as Special Study No. 2 of the Science Secretariat.¹ This document, which we shall refer to as the "CAP Survey", was then distributed to all members of CAP and was sanctioned by the membership at the annual meeting in June, 1967. This was an achievement of which the Association is justly proud; within the span of one year, and almost entirely with voluntary labour, a report had been commissioned, a contract negotiated, a massive study of Canadian physics carried out, and a report written, published and sanctioned by the physics community. Some excerpts and the major recommendations are reprinted from the CAP Survey in Appendices B, C and D.

22. The annual meeting of CAP in June, 1967 established a follow-up committee to critically examine the CAP Survey. The follow-up committee went back to the physics community to solicit remarks and criticisms; some minor criticisms were made but by and large the CAP Survey received further sanction. A committee on implementation of the CAP Survey was also established by CAP and its recommendations sent to the Science Council. Furthermore, as a direct result of the recommendations in the CAP Survey for increased support of industrial research and applied physics, CAP asked its industrial physics committee under Dr. Alan Carswell, then of RCA Victor and now at York University, to make a special survey of the state of applied physics in Canada. The report of this committee¹, which was published in July, 1968, and widely circulated in reprint form, has been very well received and has already had some impact on the teaching programs in physics departments of several major Canadian universities. Finally, in the fall of 1968 during the preparation of the present brief, a questionnaire was sent out to the membership of CAP to solicit views on the state of physics in Canada. The concerns which arose from this survey will be discussed briefly below, but substantially the physics community stands behind the CAP Survey and regards its general assessment and recommendations as still valid today.

23. In retrospect, one can say that the CAP Survey has had some impact on science policy over the past two

years, but broad implementation has not taken place and this remains the primary concern of the physics community.

24. We now turn to the specific concerns of the physics community as revealed in the recent survey conducted by the committee on preparation of this report. The first concern is for a rational science policy and for improved communication between the three estates, the science community, the public and the government. It is particularly essential for the health of the science community that those who make decisions and establish science policy have the confidence of the younger members of the science community. In the last analysis, this may require some form of direct, and democratic representation from the science community on Treasury Board and other government agencies which formulate and effect science policy.

25. The second concern is for increased support for physics education and research. Increased support is essential for two reasons: first, it is essential to the welfare of a young and dynamic country like Canada, so richly endowed with natural resources, to have a strong and viable community of research physicists; second, it is essential to the well-being and independence of a modern industrial nation that non-scientists, particularly those at the managerial level, and involved in the industrial hierarchy, receive a sound training in the sciences. In this latter regard we again note that the Organization for

Economic Cooperation and Development, has attached great significance to the higher level of education of Americans in the industrial hierarchy in terms of willingness and ability to innovate.⁶ It is difficult to innovate without experience and understanding. Understanding requires a sound education in the basic principles of physical science; experience, at least in many cases, should include research experience at the postdoctorate level in basic and applied physics.

26. The third concern is with the lack of opportunities in Canada for young Canadian science graduates. One might argue that lack of opportunity indicates oversupply were it not indicative of an underlying and more fundamental problem, viz. the lack of a research base in Canadian industry.⁷ The situation is at once distressing and critical. It is distressing that in this modern industrial state with our wealth of natural resources, young Canadian scientists and engineers have to leave their homeland because of unemployment; it is critical because the process of generating new wealth in our society largely derives from science-based technological innovation -- unless we explicitly recognize this fact, it is meaningless to talk of achieving economic and political independence for the Canadian nation.

27. A fourth concern is with the need to supplement university-based research facilities with cooperative facilities or institutes, shared by all Canadian universities

on an interest basis. Such shared facilities have a number of distinct advantages: they provide outstanding research laboratories which individual universities cannot afford; they encourage interdisciplinary research activities between various specialist groups, both within the field of physics itself, and also between physics and related disciplines such as chemistry, metallurgy, biology and medicine; and finally, they encourage contact between basic and applied physicists, and between universities and industries.

28. A fifth concern is with the proper balance between basic and applied research. In establishing a science policy for Canada, there is always a danger that immediate and pressing social needs will lead to a growth of mission-oriented applied and developmental research at the expense of basic research. Basic research is fundamental to our culture; moreover, basic and applied research are fundamental to each other. The physics community strongly supports the need for much more industrial physics in Canada, but not at the expense of our basic research activity. Quite the opposite; expanded growth in basic physics is essential to a rapid growth in industrial research. Moreover, it should be borne in mind that the cost of basic research is relatively small compared to applied research and development costs.

29. The recommendations set out below are based upon the five major concerns expressed above; in large part they rephrase in the light of present circumstances, the general recommendations of the 1967 CAP Survey. The main detailed recommendations in the CAP Survey relating to special circumstances and to special disciplines still stand as they did when the Survey came out two years ago; we have reproduced them in skeleton form in Appendices B, C and D.

V. Major Recommendations of the Canadian
Association of Physicists - Association
Canadienne des Physiciens

The Canadian Association of Physicists recommends
on:

1. Need for effective communications between scientists,
government and the public:
 - (i) that the mechanism for making science policy in
Canada be clarified by the Federal Cabinet;
 - (ii) that communications be improved between those in
government who set science policy, the members of
the scientific community and the public at large;
 - (iii) that the science community have direct representation
on those agencies of government that effect science
policy, in particular on the Treasury Board.
2. Need to support physics research as a contribution to
the social, cultural and economic well-being of Canada:
 - (i) that support for basic and applied physics research
over the next few years follow in the main the
recommendations of the CAP Survey (See Appendices B,
C and D);
 - (ii) that special emphasis be given to developing physics
research in industrial laboratories and to the
related problem of providing young Canadian scientists
the opportunities to pursue meaningful and productive
careers in Canadian industry;

- (iii) that special attention be given to the support of those branches of physics which have to do with the rational exploitation of our natural geography and our national resources;
- (iv) that an organization be established to encourage and support the development of large national research facilities emphasizing both the university and industrial communities.

3. Need for physics education:

- (i) that steps be taken, primarily through the schools and the communications media, to bring the scientist and the public together in an atmosphere of common respect and concern for social, political and economic issues; in today's language this means improving science education for society and social education for the scientist;
- (ii) that steps be taken to educate industrial entrepreneurs to the advantages of a science-trained and research-oriented managerial class in providing innovation and improving the production and marketing of Canadian products;
- (iii) that steps be taken to improve the liason between university scientists involved in basic research, and industrial scientists and engineers involved in applied science and development technology.

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Appendix A. Information Brochure on Canadian
Association of Physicists



THE CANADIAN ASSOCIATION OF PHYSICISTS

L'ASSOCIATION CANADIENNE DES PHYSICIENS

151 Slater, Suite 903, Ottawa 4.
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Français au verso

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| British Columbia and Yukon: | J.F. Cochran | A.V. Gold |
| Alberta: | J.T. Sample | A.W. Harrison |
| Manitoba and Saskatchewan: | J.L. Wolfson | R.D. Connor |
| South West Ontario: | C.M. Carmichael | G. Szamosi |
| Central and Northern Ontario: | R.L. Armstrong | D. Frood |
| Eastern Ontario: | C.H. Millar | A.G. McNamara |
| Quebec: | L. Gauvin | J. Yahia |
| New Brunswick and Newfoundland: | E.R. Deutsch | G.R. De Mille |
| Nova Scotia and Prince Edward Island: | R.H. March | C.K. Ross |
| At large: | W. Pieczonka | |

BUSINESS OFFICE

151 Slater, Suite 903, Ottawa 4, Ontario, Telephone (613) 237-3392
Executive Secretary: Jean-Louis Meunier

THE OBJECTS OF CAP ARE:

- . to further the advance of the Science of Physics;
- . to promote the use of physical discoveries in the interests of mankind;
- . to promote knowledge in the physical sciences and the dissemination of information relating thereto in and between all sections and regions of Canada;
- . to advance mutual understanding and cooperation between physicists on the one hand, and universities, research organizations, and industry, on the other.

WHAT CAP IS

- . CAP was founded in 1945 and incorporated in 1951;
- . CAP now has over 1400 members and affiliate members;
- . CAP has over 20 corporate members;
- . CAP has published the bulletin Physics in Canada since 1945;
- . CAP has organized an annual congress since 1946: over 600 individuals registered and 274 papers were presented at the annual congress held at the University of Calgary in June 1968;
- . Members can also join specialized subject divisions:
 - Theoretical Physics Division
 - Earth Physics Division
 - Medical and Biological Physics Division
 - Solid State Physics Division
 - Plasma Physics Division

Two additional divisions are in an advanced stage of formation: a Nuclear Physics Division and an Educational Physics Division.

WHAT CAP DOES FOR THE COMMUNITY

Through annual membership fees members support services and activities such as:

- . Holding high school prize examinations in physics in each of the 10 provinces of Canada: \$4,200 were distributed in prizes to 40 students in 1968.
- . Sponsoring university prize examinations in physics for undergraduate students in their final year.
- . Distributing free of charge a booklet on careers in physics for high school students.
- . Sponsoring lecture tours: 11 lecturers visited 47 institutions across Canada in 1968.
- . Supporting of undergraduate activities: the Association contributes to the support of activities such as the 4th Annual Undergraduate Physics Conference held at the University of Manitoba in October 1968.
- . Administering an Educational Trust Fund: a special fund where donations from members and industry, and contributions from the general fund are accumulated and used for educational purposes.
- . Awarding an Annual Medal for distinguished achievement in physics. The 1968 recipient was Dr. R.E. Bell, FRS.
- . Production of special reports on the state of physics in Canada.

WHAT CAP DOES FOR MEMBERS

Services offered by CAP to members include at present:

- . The Annual Congress of CAP
- . Free subscription to Physics in Canada
- . Opportunity to subscribe at reduced rates to
 - The Canadian Journal of Physics
 - The Canadian Journal of Earth Sciences
 - Contemporary Physics
 - The Physics Teacher
- . Providing various services for the organization of topical and regional conferences and summer schools.
- . Placement service - now being established.

CURRENT ACTIVITIES

The following list of committees and chairmen for 1968-69 gives some indication of the broad programme of CAP activities.

| <u>Committee</u> | <u>Chairman</u> |
|--|-----------------|
| 1. Executive Committee | M.P. Bachynski |
| 2. Finance Committee | L.E. Trainor |
| 3. Membership Committee | J.L. Meunier |
| 4. Educational Trust Fund Committee | J.L. Meunier |
| 5. Editorial Board of Physics in Canada | E.W. Vogt |
| 6. Publications Committee | E.W. Vogt |
| 7. High Energy Physics Committee | E.P. Hincks |
| 8. Applied Physics Committee | A.I. Carswell |
| 9. Nominating Committee | H.E. Petch |
| 10. Awards Committee | D.A. Keys |
| 11. Student Affairs Committee | M.W. Johns |
| 12. Distinguished Lecturers Committee | G.M. Volkoff |
| 13. Secondary School Science Examination Committee | J.S. Fraser |
| 14. Programme Committee - Annual Meeting | D.D. Betts |
| 15. Local Committee - Annual Meeting | J. Grindlay |
| 16. Committee on Prizes and Honours | H.L. Welsh |
| 17. Committee on the Revision of the Constitution | D.D. Betts |
| 18. Committee on the Sponsorship of Summer Schools | E.W. Vogt |
| 19. Committee on Science Policy | J.M. Robson |
| 20. Committee on Senior Scientific Appointments | H.E. Petch |
| 21. Committee on Placement Service | D.D. Betts |

NATIONAL OFFICE

A permanent national CAP office has been opened in Ottawa in 1968 to provide the necessary services to the members of the Association and to the members of the physics community in general. The CAP office will supply the proper agencies with information and advice on questions pertaining to physics in Canada. It will also enable CAP to more expeditiously undertake and conduct studies on problems pertaining to physics and to the development of science and technology in Canada.

WHAT CAP HAS DONE

In the last few years some of the major realizations of CAP have been the preparation of the reports and the sponsorship of the conferences and summer schools listed below.

- . A Statistical Report on Canadian Physicists
Physics in Canada, Special Issue, Vol. 21, No. 3, 55 pp. (1965)
- . Physics in Canada: Survey and Outlook
Special Study, Science Secretariat, Queen's Printer, 385 pp. (1967)
- . Applied Physics in Canada
Physics in Canada, Vol. 24, No. 4, pp. 20-51 (1968)
- . Theoretical Physics Summer Institute,
McGill University, August 1967, 185 participants.
- . Fourth Canadian Annual Conference on High Energy Physics,
Carleton University, November 1967, 100 participants.
- . Summer School on Critical Phenomena,
Banff, August 1968, 140 participants.

ADMISSION TO MEMBERSHIP

A person may be enrolled as a member if he has a bachelor's degree in physics or a related subject, and if his principal employment is in the area of physics.

A person may be enrolled as an affiliate member if he has a bachelor's degree in a subject unrelated to physics or if he holds an approved membership in another professional association. The affiliate grade of membership is designed for those whose principal occupation cannot be described as physics, for physicists permanently resident outside Canada and for non-Canadian physicists temporarily resident in Canada.

A person may be enrolled as a student member if he is registered in a course leading to a bachelor's degree in physics or a related subject, or if he is registered in an approved postgraduate diploma course (e.g. College of Education but not a master's or doctor's degree program in physics).

Any queries should be sent to the Executive Secretary who can assist an applicant in selecting the appropriate grade of membership. Membership fees are as follows:

| | | |
|--------------------|-----------------|---------|
| Full members: | age 30 and over | \$22.00 |
| | below age 30 | 9.00 |
| Affiliate members: | age 30 and over | 15.00 |
| | below age 30 | 7.00 |
| Student members: | | 2.00 |

Appendix B. CAP Survey: General Recommendations

The following recommendations are abstracted from Physics in Canada: Survey and Outlook (Queen's Printer, Ottawa, 1967) pp. 50-52:

In this section we present eight general recommendations as a basic structure for the orientation of government policy on physics research during the next five years. We have used these guidelines in proposing our more detailed recommendations outlined in Sections 4.2 to 4.7.

1. Pure and applied physics

The distinction between these two aspects of physics research has already been outlined. We feel that whereas pure research is in a reasonably healthy state and is continuing to improve, the same cannot be said for applied physics. Our first general recommendation is that special consideration must be given to strengthening the research effort in applied physics. In particular, the universities must be encouraged to undertake more research oriented toward applied physics in order to improve the flow of graduates with an interest in such work, and Canadian industry must be encouraged to undertake more of its own research in Canada. To enable it to do this it needs more incentives, and with this in mind we offer more specific recommendations in Section 4.6.

2. Applied and interdisciplinary aspects of physics in the universities

In order to put our first recommendation into effect it is of paramount importance that the universities recognize applied physics as an honorable part of physics. Though this recognition must clearly take place at the graduate level it is equally important that it begin at the undergraduate level. The same may be said about such interdisciplinary aspects of physics as geophysics and biophysics. Our second general recommendation, therefore, is to urge more universities to create prestige courses in physics with special options oriented towards applied physics and the interdisciplinary aspects of physics.

3. Fields of physics that are healthy at the moment

It would be folly to withdraw support from fields in which Canada has already succeeded in making notable contributions and has good prospects for continuing to do so. Our third general recommendation is, therefore, to continue support of such fields at a rate such that they are likely to maintain or improve their present position.

4. Fields connected with our natural resources

We consider that a major aim of our research effort in the near future should be to enable our own industries to take better advantage of our immense natural resources. This is a logical consequence of the decision of Canadians not to be merely diggers and exporters of their

wealth. Our fourth general recommendation is, therefore, to greatly increase the support for all forms of research in basic and applied physics that are connected with the conservation or rational exploitation of our own natural resources.

5. Peculiarly "Canadian" fields

Due to its geography Canada provides a unique area for research in fields of physics that involve large land areas, a long sea coast, arctic conditions, and northern latitudes. Furthermore, the tilt of the earth's magnetic axis toward northern Canada makes measurements in Canada, of certain phenomena, necessary for the solution of many problems related to the physics of the earth as a planet. We feel that such research, which makes use of our geographical position, should be strongly encouraged. Our fifth general recommendation is, therefore, to maintain at an adequate level and, where necessary, to increase substantially, support for fields of research for which our terrain and location give us a natural advantage over other countries.

6. Joint institutes

There is a well-recognized tendency for the cost of the facilities needed for research to increase rapidly with time in several fields of physics. As progress is made, increasingly complex problems are tackled and increasingly more complicated equipment is needed for their

investigation. In nuclear physics this takes the form of large accelerators; in astronomy it is telescopes; in solid state physics it is magnets, electron microscopes, and other complex measuring equipment. Such facilities are, in general, far too expensive to build and to operate to be just associated with one laboratory, even a large government laboratory. They must be shared between physicists working at many different laboratories. Our sixth general recommendation is, therefore, to set up joint institutes that will provide major facilities for the use of several laboratories. Such institutes must not be under the exclusive control of government laboratories but must be operated in a manner that permits universities and industry to share in their control. In Appendix E we attach a memorandum on this subject, submitted to the Spinks report by Professor H. L. Welsh of the University of Toronto. We are in complete agreement with the principles expressed in this memorandum. We discuss this recommendation in more detail in Section 4.4.

7. Theoretical physics

The committee on theoretical physics clearly emphasizes that this subject is more than a single branch of physics; it is a vital part of each branch. The report also emphasizes that in some fields the level of the theoretical program is well below the level appropriate to the existing experimental program, and that in some areas it is even dangerously low. Our seventh general

recommendation is, therefore, to give sufficient support to theoretical physics in the broad sense to enable it to come into balance with experimental physics in all fields and in all major research laboratories.

8. Fundamental pure physics

The strengthening of research in applied physics, which we have emphasized in some of our general recommendations above, can only be effective if it rests on a firm foundation of continuing research in pure physics. This type of research also makes a vital contribution to Canada's cultural development, and we hope our desire to strengthen applied physics will not be interpreted as a suggestion to weaken pure physics.

Our eighth general recommendation is, therefore, to continue to increase support for research in pure physics in order that it will always form an adequate base for an increased engagement in applied physics, and in order that Canada will continue to contribute to man's fundamental knowledge of matter.

Appendix C. CAP Survey: Financial Recommendations

The following recommendations are reprinted from Physics in Canada: Survey and Outlook (Queen's Printer, Ottawa, 1967) pp. 71-76. The reader is referred to the CAP Survey itself for their detailed justification. Numbers 3 and 4 below are concerned with the establishment and support of joint research laboratories; since the CAP Survey recommended development of the ING (intense neutron generator), the figures in number 4 included \$26 million support for this project.

1. That the average annual increase in the support of research in physics should be 23% per annum over the next five years. This should be made up of a 25% annual increase to the universities, a 15% annual increase to government laboratories, and a 44% annual increase in the support of physics research in industry (Section 4.3, page 67);
2. That the federal government grants for the support of physics research should be increased at an annual rate of 36% over the next five years (Section 4.3, page 71);
3. That the federal government set up a committee composed of scientists from universities, from industry and from its own laboratories, to prepare a policy for the organization and operation of

joint institutes (Section 4.4, page 72);

4. That financial support be available on an increasing scale and up to \$45 million per annum by 1971 for the support of joint institutes, and that this support be considered quite separate from the support recommended above (recommendations 1 and 2) (Section 4.4, page 76).

Appendix D. CAP Survey: Support of Research
in the Universities, Industry
and Government Laboratories

The following recommendations are reprinted from
Physics in Canada: Survey and Outlook (Queen's Printer,
Ottawa, 1967) pp. 77-83.

Research in Universities (Section 4.5, pages 77-80)

1. That the National Research Council of Canada continue to be a primary distributing agent of federal government funds for research, with a budget completely and clearly separated from its own operating expenditures;
2. That other government agencies should continue to give grants to support university research in their special fields of interest, and that a proper exchange of information should be effected between all granting agencies;
3. That provision be made whereby an applicant, if supported by the head of his department, can obtain an explanation of the reasons for the size of his award;
4. That block grants and term grants should be reinstated, and that term grants should carry with them a guaranteed annual increment of 10%; grantees of term grants should be able to apply

for an increment above the 10% after two years of a three or more year term grant;

5. That grants for the operation of facilities should be made separately from those to the individuals who will use them, should be assessed by visiting committees, and should be awarded for extended periods with provision for escalation and for supplements on appeal;
6. To introduce "Joint Grants" to be applied for under the patronage of a senior scientist by a "new man" getting started at a larger university, and to introduce negotiated "Development Grants" for "new men" at smaller universities and for new men starting new fields at larger universities.

Research in Industry (Section 4.6, pages 80-82)

1. That the government substantially increase the number and extent of the fully-funded long-term research programs offered to industry;
2. That the present cost-sharing programs be put on a sliding scale with the government-to-industry cost ratio being determined by the basic-research to applied-research content ratio of the program;
3. That aid should be made available to scientists in industry for the support of unsolicited projects;
4. That Canadian industry should be given a substantial

research role in any major new program that may be initiated, particularly if the programs are "mission oriented"

5. That, where applicable, each production contract from the government carry with it a closely scrutinized grant for research of 2 to 3% of the value of the contract;
6. That existing tax incentives for research and development in industry have considerable value and should be continued;
7. That arrangements be made whereby government and university physicists be encouraged to spend one or two years in industrial research laboratories;
8. That provision be made for postdoctorate fellowships in industrial research laboratories.

Research in Government Laboratories (Section 4.7, pages 80-83)

1. That research support should be adequate to enable government laboratories to grow in a manner befitting the developing nature of Canada's economy. We feel that this will be accomplished by a 15% annual increase in the level of support over the next five years.

ADDENDUM
TO THE
BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE OF THE SENATE
ON
SCIENCE POLICY

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS

April 1969

Addendum to BRIEF SUBMITTED TO THE SPECIAL COMMITTEE OF
THE SENATE ON SCIENCE POLICY
by the CANADIAN ASSOCIATION OF PHYSICISTS

I. SUMMARY

The Canadian Association of Physicists (CAP), as the only democratic voice in Canada capable of speaking for the organization and support of physics, has an important responsibility in regard to the social development of modern physics and its intellectual and economic impact on Canadian society. It can fulfil its role by undertaking national projects of a socio-scientific nature.

Since the submission of its brief to the Special Committee of the Senate on Science Policy, the Canadian Association has become acutely aware of the situation in Canada which prevents it from performing this national function. The problem is that there is no tradition in Canada of funding of such national projects outside of government organizations. The net result is that the Association has been singularly unsuccessful in obtaining grants for national projects in spite of a number of attempts to do so. The nature of these projects is similar to those being performed for the U.S. national environment by the Association's sister-society in the United States - the American Institute of Physics. Such projects are being generously funded in the United States by the National Science Foundation. It is felt that this problem is common to most national scientific societies in Canada. Those societies in the forefront of current developments are feeling the urgency of the present situation more acutely.

The Canadian Association of Physicists recommends that the role of scientific societies in the development of a given scientific discipline be recognized and that a fraction of the national budget in a given discipline (of the order of 1/2 of 1% of the expenditures on

r & d) be used for the support of national projects to be undertaken by such societies. To implement these projects it is further recommended that the responsibility for and budget to fund such projects be clearly identified and given to a specific department of government or government agency to administer.

II. THE ROLE OF A SCIENTIFIC SOCIETY IN CANADA AND CURRENT SITUATION IN PHYSICS

The main national functions that need to be performed by a scientific society are encompassed within the topics - publications, meetings, science and education, science and society, history and philosophy of science, manpower, and information analysis and retrieval.

In relation to physics in Canada, the publication functions are carried out by the National Research Council through publication of the Canadian Journal of Physics and by the CAP through publication of "Physics in Canada" and various abstracts of meetings. The scientific meetings are conducted by the CAP through the annual congress, specialist meetings of the subject divisions of CAP and jointly sponsored CAP - American Physical Society conferences. Some physics and education projects are conducted by CAP through its Educational Trust Fund which is supported through donations from industrial Corporate Members. Since a substantial physics industry does not exist in Canada, industry employs relatively few physicists. Hence large donations to CAP are not to be expected. The small magnitude of the Educational Trust Fund puts severe financial restrictions on the activities that can be supported. Major employers of physicists in Canada are government laboratories & Crown Corporations. To date, none of these government organizations have seen fit to support CAP as Corporate Members.

Projects on physics and society, history and philosophy of physics, manpower, information analysis and retrieval and to a lesser degree physics and education are generally neglected in Canada. This is a particularly unfortunate situation since it is these activities which determine the degree of maturity of a science in Canada and, in particular, its Canadian identity. The social development of modern physics and its intellectual and economic impact on Canadian society should be of vital concern particularly during this current critical period in the examination and formulation of a science policy for Canada. With the dynamic pace of modern science there will exist a continuing need for such investigation, re-examination and re-appraisal.

In fact, these latter functions are more important to the development of a Canadian science than the publication and meetings functions. The Canadian scientific community, due to the magnitude of research conducted in the United States, must attend American meetings, study American publications and if they want their own work widely read, publish in U.S. journals. If the only function a Canadian scientific society offered its members was journal publication and the organization of meetings, it would have considerably less to offer than its U.S. counterpart and hence Canadian scientists need only to belong to the American Societies. We cannot overstress that it is the science and Canadian society elements in their various facets that the Canadian scientific societies and associations have to perform in order for a mature and meaningful scientific discipline to develop in this country.

Returning to physics in Canada, the overall expenditures in physics in 1966, by type of employer, were as follows: (Physics in Canada; Survey and Outlook, Science Secretariat Special Study No. 2, Queen's Printer, May 1967, p. 70)

| | | |
|-------------------------|---------------|-----------|
| Government laboratories | 36.9 millions | 52% |
| Universities | 28.3 " | 40% |
| Industry | <u>5.0</u> " | <u>7%</u> |
| | 70.2 millions | 99% |

This represents some 10% of the total expenditures for research and development in Canada (Economic Council of Canada, Fifth Annual Review, Sept. 1968, p. 50). It is also of interest to point out that the number of graduate students in physics, over the last three years, accounts for 10% of the total number of graduate students in all fields of science and engineering.

These statistics are presented here to indicate that with the substantial annual expenditures on physics, attention is warranted to the functions of a Canadian Scientific Society in this discipline in order to insure the proper development of physics in Canada and to maintain its relevance to our national situation.

III. THE PROBLEM - A VEHICLE FOR SUPPORT OF PROJECTS UNDERTAKEN BY SCIENTIFIC ASSOCIATIONS IN CANADA

The Canadian Association of Physicists has recognized for some time the need and urgency of the role that it should fulfil in regard to physics in Canada. The Association established a permanent national office and hired a full-time Executive Secretary in May 1968 as a first step in an effort to undertake projects such as those indicated earlier. The aim was to obtain grants to perform national projects appropriate for the development of physics in Canada and the determination of its role in Canadian society.

At the same time efforts were made to obtain grants for the Canadian Association of Physicists to establish its national office and undertake special projects. To date, however,

the Canadian Association of Physicists has been singularly unsuccessful in obtaining support for national projects from Canadian government bodies, despite a continued number of attempts to do so. (A sole exception is the Special Study No. 2, "Physics in Canada - Survey and Outlook" which was undertaken in 1966 for the Science Secretariat.)

The nature of many of the projects for which support was requested was similar to those being done for the U.S. environment by CAP's sister society, the American Institute of Physics, in the United States, where such projects are being generously funded by the National Science Foundation.

The net result is that the Canadian Association of Physicists now faces severe financial problems, and a decision as to whether to close down the National office must be faced. It is considered that this would be a retrograde step for physics in Canada from which it would require at least a decade to recover.

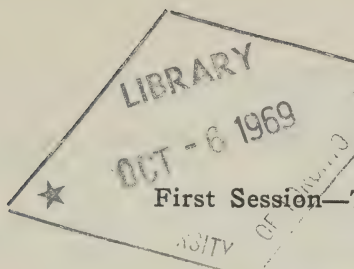
The problem, as seen by the Canadian Association of Physicists, is that there is no tradition in Canada of funding projects outside of government establishments even in cases where it is clearly evident that a particular organization may be ideally suited to execute such projects. There is also no assigned responsibility for or even acute awareness of those activities which involve the physics community and society-at-large. It is then perhaps not surprising that no government agency, although it may be sympathetic to the views expressed here, is prepared to assume the responsibility to insure that such projects are carried out. These activities are, however, essential for a democratic development of physics in Canada which is relevant to the society in which we live.

Hence, the Canadian Association of Physicists considers that some vehicle must be found to support these activities.

IV. RECOMMENDATIONS

The Canadian Association of Physicists recommends:

- (i) That the essential role of scientific societies in the development of a scientific discipline be recognized. Projects on science and society, history and philosophy of science, manpower, education and science, information retrieval and analysis, etc. must be supported since these will reflect the developing maturity of science in Canada and, in particular, its national relevance and national identity.
- (ii) That a fraction of the national budget in a given discipline (say $\frac{1}{2}$ of 1% of the total expenditure on r & d) be set aside for the support of such projects.
- (iii) That the responsibility for such projects and the budgets to fund them should be clearly identified and given to a specific department of government or government agency to administer. National scientific associations should be encouraged to submit projects for consideration with reasonable assurance of support as is the situation in the United States with the National Science Foundation.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 56

FRIDAY, JUNE 6th, 1969

WITNESSES:

National Committee of Deans of Engineering and Applied Science: Dr. J. W. Hodgins; Association of Consulting Engineers of Canada and Association of Professional Engineers of the Province of Manitoba: Carson H. Templeton; Engineering Institute of Canada: Brigadier General Jean P. Carrière, President, Dr. Richard C. Quittenton, Chairman, Engineering Research and Development Committee, Mr. W. W. Southam, Engineering Research and Development Committee.

APPENDICES:

- 115.—Brief submitted by The National Committee of Deans of Engineering and Applied Science
- 116.—Brief submitted by the Association of Consulting Engineers of Canada
- 117.—Brief submitted by the Association of Professional Engineers of the Province of Manitoba
- 118.—Brief submitted by The Engineering Institute of Canada

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*
The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

FRIDAY, June 6, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.05 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Carter, Grosart, Kinnear, McGrand, Phillips (*Prince*), Robichaud, and Yuzyk—8.

Present but not of the Committee: The Honourable Senator McDonald—1.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

National Committee of Deans of Engineering and Applied Science:
Dr. J. W. Hodgins.

Association of Consulting Engineers of Canada,

Association of Professional Engineers of the Province of Manitoba:
Carson H. Templeton, P.Eng.

Engineering Institute of Canada:

Brigadier-General Jean P. Carrière, President
Dr. Richard C. Quittenton, Chairman
Engineering Research and Development Committee
Mr. W. W. Southam,
Engineering Research and Development Committee

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

No. 115—Brief submitted by The National Committee of Deans of Engineering and Applied Science.

No. 116—Brief submitted by the Association of Consulting Engineers of Canada.

No. 117—Brief submitted by the Association of Professional Engineers of the Province of Manitoba.

No. 118—Brief submitted by The Engineering Institute of Canada.

At 12.15 a.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Carrière, Brigadier General Jean P. Brigadier General Jean P. Carrière, E.D., Eng., M.E.I.C., the 1968-69 President of The Engineering Institute of Canada, brings to this task impressive experience as an engineer and administrator with a wide knowledge of the Institute's affairs derived from service to its local and national committees since he first took office on committees of the London Branch in 1938. Born in 1907 at Hull, Quebec, General Carrière was educated at the La Salle Academy, the University of Ottawa, by private tuition, and at the War Staff College, Kingston, Ontario. He started his career in the Public Works Departments of Ottawa, Rimouski and London. After further service in this field as Chief Engineer of two Montreal construction companies, in 1954 he became Chief Engineer, Public Works Department, Ottawa. Since 1963 he has been President, Franki Canada Limited and he is a director of several other nationally known companies. He was Chief Engineer on the blasting of Ripple Rock, B.C., on the 2nd Section Beauharnois Hydro-Electric project and on the organization for the Trans-Canada Highway. On active service in World War II, he was twice mentioned in despatches, honoured as an Officer of the Ordre de la Couronne of Belgium and as a Chevalier de la Légion d'Honneur—Croix de Guerre avec Palme of France. He was Deputy Chief Engineer of the Canadian Army (permanent Rhine Bridges) in 1945 Aide de Camp to the Lieutenant Governor of Quebec (1947-51) and Aide de Camp to the Governor General of Canada (1951-54). During this energetic career he has found time to write a number of technical articles on civil and military engineering for The Engineering Journal—the publication of E.I.C.—and for the American Society of Mechanical Engineers. He is a Member of the Corporation of Engineers of Quebec, the Association of Professional Engineers of Ontario and the Association of Military Engineers of Canada and a Fellow of the American Society of Professional Engineers. His keen interest in life and vigorous intellect have found relaxation in his favourite sports of golf, skiing, bowling and fishing. He shows his public spirit as a Life Governor of Notre Dame Hospital, Montreal. He and his delightful wife have two sons, one of whom is an engineer, and a daughter, now all married.

Hodgins, J. W. B.A.Sc., Ph.D., F.C.I.C., P.Eng. Born: September 1917; Married, one daughter. Education: (a) Ontario Primary and Secondary Schools (Thorold). (b) University of Toronto: B.A.Sc. (Honours), Chemical Engineering, 1938. (c) University of Toronto: Ph.D. Physical Chemistry, 1947. Military Service: Canadian Active Army, 1942-1945 Chemical Warfare Laboratories, discharged (Captain), 1945. Professional Record: Phase I, 1938-1940, Research engineer, Algoma Steel Corporation Sault Ste. Marie, Ontario. Phase II, 1940-1945, Research scientist, Chemical Warfare Laboratories, Ottawa (the last three years as a serving army officer). Phase III, 1945-1947, Graduate student, Department of Chemistry, University of Toronto. Phase IV, 1947-1950, Section Head, Physical Chemistry Section, Defence Research Chemical Laboratories, Ottawa. Phase V, 1950-1956, Professor of Chemical Engineering, Royal Military College of Canada, Kingston, Ontario. Phase VI, 1956-1969, Professor of Chemical Engineering, Dean of Engineering McMaster University, Hamilton, Ontario.

June 30, 1969; Retiring from Deanship, McMaster University. Professional Research Experience: (* denotes publications in a referee journal). Phase I, Plant research investigations, integrated steel industry (iron ore sinter process, slag wool process, material balance, tinplate production control). Phase II, Physical chemistry research on (a) detection of microconstituents in the atmosphere. *(b) Physical adsorption and surface chemistry of adsorbed material. (c) Development of chemical weapons. Phase III, *Physical chemistry research: The formation and properties of free vinyl radicals. (Ph.D. program, Supervisor—D. J. LeRoy). Phase IV, Physical chemistry research *(a) Production of the Trifluoromethyl radical by the sodium flame method. *(b) Properties of solutions of alkali metals in liquid ammonia. Phase V, Physical chemistry and chemical engineering research: *(a) Structure of solutions of alkali metals in liquid ammonia and aliphatic amines. *(b) Influence of sonic vibrational energy on gas-solid mass transfer. Phase VI, Chemical engineering research: *(a) Effect of sonic vibrational energy on gas-solid and gas-liquid interfacial mass transfer. *(b) Gamma-initiated chemical chain reactions (halogenation of aliphatic hydrocarbons). *(c) Gel permeation chromatography as a tool in the design of polymerization reactors. *(d) Gamma initiated polymerization reactions. (Graft co-polymerization in wood substrate; gamma-initiated homopolymerization in pure and dilute polymer systems). (e) The development of a ferromagnetic fluid. Professional Administrative Experience Phase I, (a) Supervised metallurgical quality control laboratory (7 employees). (b) Designed and supervised plant experiments (5-25 participants). Phase II, Supervised small research team: 2-8 technical staff. Phase IV, Supervised small research team: 2-8 technical staff. Phase V, Designed, built, and staffed, the chemical engineering laboratories, Royal Military College. Developed departmental curriculum and research program, Department of Chemical Engineering, R.M.C. Phase VI, (a) Developed curriculum, assembled staff, directed the design of the facilities for the new Faculty of Engineering, McMaster University. (b) Guided the development of the research program in the Faculty of Engineering—(in 1968, five departments are pursuing work to the Ph.D. and there is a total of about 175 graduate students). (c) Guided the formation and assembly of finances of the Centre for Applied Research and Engineering Design (an Industrial Research Institute, partially financed by the Department of Industry). (d) Guided the establishment of the new Applied Dynamics Laboratory (a west-campus facility, opened June, 1968).

PROFESSIONAL OFFICES HELD

1. *Chemical Institute of Canada*: Local section executive, local section chairman (Kingston), divisional executive, divisional chairman (Chemical Engineering Division), Councillor B (Chemical Engineering Division), Director of Professional Affairs, member of Steering Committee for Science Secretariat Survey.
2. *National Research Council of Canada*: Member, Advisory Committee on Applied and Engineering Research, 1966. Member, Scholarship Committee, 1967. Member, Associate Committee on Scientific Information, 1966.
3. Member, Advisory Committee on Science and Medicine, Expo '67 (1965-1967)
4. Member, *Ontario Engineering Advisory Council*.

5. Chairman, *National Committee of Deans of Engineering and Applied Science*, 1966, 1967.
6. Member, Committee of Ontario Deans of Engineering, 1968.
7. Member, Board of Directors, Hamilton Geriatric Centre, 1966-.
8. Member, McMaster University Senate, 1958-.
9. Member, Board of Governors, McMaster University, 1963, 1968.
10. Member, Board of Governors, Mohawk College of Applied Arts and Technology, 1966-.
11. McMaster University—internal committees: (a) Senate: (i) Discipline committee (ii) Executive committee (iii) Vacancies and appointments committee (iv) Curriculum committee (v) Graduate Studies (vi) Semester study (Chairman) (vii) Nominating committee, (b) Special assignments: (i) Recommendation of candidate for Registrar (Chairman). (ii) Recommendation of candidate for High School Students Relations Officer (Chairman). (iii) Faculty Club Facilities Committee (Chairman). (c) Ex-officio membership: all Faculty Committees in Engineering.

Publications: A bibliography of scientific publications is appended. *Patents:*

1. Mass Transfer from Solid to Gaseous Stage by Means of Sonic Energy with T. W. Hoffman. Canadian Patent Number 613,431, U. S. Patent Number 721,276.
2. Radiochlorination of Methane with G. N. Werezak. Patents applied for: Canada, U.S. (app. No. SN. 562,819). *Awards:* 1. Canada Centennial Medal, 1967. 2. OECD. Fellowship, 1964. 3. N.R.C. Lecturer to France, 1968.

PUBLICATIONS: (J. W. HODGINS)

1. "Coordination Compounds of 1:3, Diaminoisopropanol" by J. W. Hodgins and J. G. Breckenridge. *Can. Jour. Research*, B17, 331 (1939).
2. 1940-45: 17 Technical reports on research in chemical warfare, all classified.
3. "An Automatic Burette for the Delivery of Gas at Constant Pressure" by J. W. Hodgins and R. B. Harvey. *Can. Jour. Research*, B24, 81 (1946).
4. "The Flow of Gases and Vapours through Porous Media": by J. W. Hodgins, E. A. Flood and J. R. Dacey, *Can. Jour. Research*, B24, 167 (1946).
5. "Persistent Currents in Frozen Metal-Ammonia Solutions", by J. W. Hodgins. *The Physical Review*, 70, 568 (1946).
6. "Reactions of Atomic Sodium", by J. W. Hodgins, A. Tickner, and D. J. LeRoy. *Can. Jour. of Research*, B26, 619 (1948).
7. "Some Properties of Cesium-Ammonia Solutions", by J. W. Hodgins. *Can. Jour. of Research*, B27, 861 (1949).
8. "Some Notes on the Properties of Metal-Ammonia Solutions", by J. W. Hodgins and E. A. Flood. *Can. Jour. of Research*, B27 874 (1949).
9. "Mercury 1850 Å° and Xenon 1470 Å° Resonance Lamps as Ultraviolet Sources for Photochemical Studies", by R. Dacey and J. W. Hodgins. *Can. Jour. of Research* B28, 90 (1950).
10. "Photosensitized Reactions of Carbon Tetrafluoride", by J. R. Dacey and J. W. Hodgins. *Can. Jour. of Research*, B28, 173 (1950).
11. "The Gas Phase Formation of Trifluoromethyl Radicals", by J. W. Hodgins and R. L. Haines, *Can. Jour. of Chemistry*, 30, 473 (1952).

12. "Chemical Engineering Education at the Royal Military College of Canada" by J. W. Hodgins, *Chemistry in Canada*, 33-35, January, 1954.
13. "Absorption Spectra of Metals in Solution", by H. Blades and J. W. Hodgins. *Can. Journal of Chemistry*, 33, 411-425 (1955).
14. "The Storage and Transfer of Low Potential Heat", by J. W. Hodgins and T. W. Hoffman. *Can. Journ. Tech.* 33, 293-302, 1955.
15. "Positron Decay in Solutions of Alkali Metals in Amine Type Solvents", by B. C. Hogg, T. H. Sutherland, D. A. L. Paul and J. W. Hodgins. *J. Chem. Phys.*, 25, 1082 (1956).
16. "The Effect of Sonic Energy on Mass Transfer in Solid-Gas Contacting Operations", J. W. Hodgins, T. W. Hoffman and D. C. Pei, *C. J. Ch. E.* 35, 18-24 (1957).
17. Canadian Patent No. 613, 431, issued January 31, 1961, entitled "Mass Transfer from Solid to Gaseous Stage by Means of Sonic Energy".
18. U.S. Patent No. 721,276, issued March, 1962, same title as above.
19. A Simple Gamma Irradiation Facility for Pool Reactors, J. M. Gebicki, J. W. Hodgins, R. H. Tomlinson. *Research Reactor Journal*, 3, 13-16 (1963).
20. A Pass at the Infinite. J. W. Hodgins, *Physics in Canada*, pp. 21-27 (1962).
21. Radiation Induced Polymerization of Styrene in Wood. K. V. Ramalingam, G. N. Werezak, J. W. Hodgins, *J. Polymer Science C*, No. 2, 153-167 (1963).
22. The Effect of Acoustic Turbulence on Mass Transfer at a Column Wall. D. I. R. Low and J. W. Hodgins, *Can. J. Chem. Eng.* 41, 241 (1963).
23. A Versatile Radiation Source for Studying Gamma-Initiated Reactions. J. W. Hodgins, G. N. Werezak, S. L. Ross, *Can. Jour. Chem. Eng.* 43, 117 (1965).
24. Irradiated Wood-Polymer Combinations—A Critique. S. L. Ross, J. W. Hodgins. *Isotopes and Radiation Technology*, Vol. 3. 3, 236 (1963).
25. The Need for a Great Canadian Engineering School, J. W. Hodgins, *The Professional Engineer and Engineering Digest*, September (1966).
26. Increased Productivity through Process Control, J. W. Hodgins, *Chemistry in Canada* pp. 25 October (1967).
27. Polymer Reactors and Molecular Weight Distribution, Part I—Free Radical Polymerization in a Continuous Stirred Tank Reactor. J. H. Duerksen, A. E. Hamielec, J. W. Hodgins, *A.I.Ch.E.* November (1967).
28. Polymer Reactors and Molecular Weight Distribution, Part II—Free Radical Polymerization of Styrene in Batch Reactor. A. E. Hamielec, K. Tebbens, J. W. Hodgins, *A.I.Ch.E.* November (1967).
29. Gamma Initiated Chlorination of Methane. G. N. Werezak, J. W. Hodgins. *Can. J. Chem. Eng.* December (1967).

Quittenton, Richard Charles. Born: Toronto, July 12th, 1921. Married: December 22nd, 1943. Children: 2 daughters—3 sons. Education: B.A.Sc. Chemical Engineering—University of Toronto, 1943. M.A.Sc. Chemical Engineering—

University of Toronto, 1947. Ph. D. Chemical Engineering—University of Toronto, 1953. War Service: Lieutenant, Royal Canadian Engineers, March, 1943 to June, 1946. European Service. Employment: 1946, Demonstrator, Dept. of Chem. Eng., University of Toronto. 1947-1949, Supervisor, Dept. of Chem. Eng., University of Toronto. 1951-1955, Senior Supervisor—Technical Division. Aluminum Company of Canada, Arvida, Quebec; in charge of development group on alumina extraction and electrolysis. 1955-1966, Research Director. John Labatt Limited, London, Ontario; personally started the Corporate diversification effort and initiated the Research Department. 1967-present, President St. Clair College of Applied Arts & Technology, Windsor, Ont., first president of this community college of 1,200 students. Professional Activities: Chairman, Arvida and London sections of the Chemical Institute of Canada and Fellow of the C.I.C. Councillor for South-Western Ontario, 1965-1968, for the Chemical Institute of Canada. Director of the Chemical Institute of Canada, 1968-1971. Chairman, Engineering Research Committee of the Engineering Institute of Canada, since 1966. Member, Ontario Engineering Advisory Council, since 1968. Adjunct Professor in Chemical Engineering at the University of Windsor, since 1968. Technical Productivity: 6 patents, some 65 internal formal corporate technical reports, various public technical papers, technical consultant to J. Labatt Limited, since 1967. Recreation: canoeing, particularly on old voyageur routes.

Southam, W. W. Born in Hamilton, Ontario, April 16, 1908. Educated Trinity College School and McGill University (B. Sc. in Electrical Engineering, 1930). Joined The Vancouver (B.C.) Province in 1930; production manager 1938-1945. Transferred to head office of Southam Press Ltd. as executive assistant 1945; elected vice-president 1954. Director and member of Executive Committee since 1950. Member, Mechanical Committee, American Newspaper Publishers Association, 1950-1959; Research Advisory Committee, ANPA Research Institute, 1959-1967. Director, ANPA Research Institute Inc., 1961-1969. Chairman, Type Readability Committee, The Canadian Press, 1956-1962. (This was the committee whose work resulted in CP's change to an improved Teletypesetter transmission standard early in 1962—later followed by The Associated Press and United Press International in the United States.) Member, Labor Relations Committee (a former chairman) and Printing Quality Committee, Canadian Daily Newspaper Publishers Association; Technical Committee, The Canadian Press. Chairman, Management Section, Engineering Institute of Canada Toronto Branch, 1962-63; member, Engineering Research Committee, E.I.C. 1969. Chairman, Membership Tours Committee, Toronto Board of Trade, 1964 to date. Vice-President, Toronto East General and Orthopaedic Hospital Research Foundation.

Templeton, Carson H., P. Eng. Age—51. Graduate of University of Alberta. Resident of Winnipeg, Manitoba. Senior Partner of Templeton Engineering Company of Winnipeg which has a staff of 145 specializing in civil, structural and systems engineering. Vice President of Teshmont Consultants Ltd. of Winnipeg which has a staff of 200 specializing in design of transmission lines. National & Professional Activities: President (1968-69) of The Association of Consulting Engineers of Canada. Board of Governors of The University of Manitoba. Member of the Executive Committee, Board of Directors, Winnipeg Childrens Hospital. Member of the Executive Committee, Manitoba Health Sciences Co-ordinating Council (which is developing a medical centre). Past

Manitoba Chairman of the Community Planning Association. Work Experience: Four years for the Federal government designing roads and airports. Two years as Manager of a branch office of a large construction company. Former Director of Flood Protection for Greater Winnipeg. Fifteen years developing a Consulting Engineering firm. This includes municipal engineering, design of bridges, highways, foundations, flood protection works; benefit cost analyses; research into permafrost in the discontinuous zone; rigid pavement research in urban streets; rate structures for utilities.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Friday, June 6, 1969

The Special Committee on Science Policy met this day at 10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, we have with us this morning three main groups and associations, and I understand a subsidiary of one of them. We have the National Committee of Deans of Engineering, the Association of Consulting Engineers of Canada, the Association of Professional Engineers of the Province of Manitoba, and the Engineering Institute of Canada. I will follow the order of my list in calling upon our witnesses for their opening statements. Without further ado, I will ask Dr. Hodgins of the National Committee of Deans of Engineering to make his opening statement.

Dr. J. W. Hodgins, National Committee of Deans of Engineering and Applied Science: Mr. Chairman, honourable senators, guests: I thought I should begin by saying how our brief came into being and give a short description of the character of the group presenting the brief.

The National Committee of Deans of Engineering and Applied Science is an associate committee of the Association of Universities and Colleges of Canada, and Dr. J. M. Dineen of New Brunswick is its Chairman for 1969-70. He is here as one of our witnesses this morning. The second witness we have with us this morning is Dr. Pierre Grenier, of la Faculté des Sciences, Université Laval, who is not only a distinguished engineer but is the only one of us distinguished enough to have his name on a big welcome sign above the marquee of the hotel this morning.

The Chairman: I hope he had nothing to do with a little incident that occurred here last night. We will see if there is a co-relation between his presence before the committee and our lighting.

Dr. Hodgins: The National Committee of Deans of Engineering and Applied Science has been meeting biannually for about ten years to debate and execute decisions of common concern in the field of engineering education and research, and it has proven to be effective and decisive. Its membership includes the deans of engineering of every degree-granting engineering school in the country. About a year ago it was decided that we should submit a brief to this Special Committee on Science Policy embracing the opinions and concerns of the engineering schools of Canada as part of the large volume of information being assembled as background for the development of a national science policy. Mr. Pocock joined us in our meeting of October, 1968, to explain the aspirations and procedures of the Senate committee, and a coordinator, J. W. Hodgins, of McMaster University, was appointed.

Submissions of opinion were solicited then from all of the deans of engineering, and their collation and condensation resulted in the brief which was submitted in English and in French—I gather somewhat shaky French—in late February, 1969. I am expressing the sentiment of all of my colleagues on the National Committee of Deans of Engineering and Applied Science when I tell you how pleased and honoured we are to have the opportunity to appear on their behalf.

You will have inferred from reading our brief that we have focussed our attention on the subject of research and development in the engineering schools of Canada.

It is in the research area where a spectacular evolution has occurred in the past decade in engineering; This is the area of endeavour in which federal policy plays its largest role; undergraduate education is, of course, a matter of provincial jurisdiction.

I think I can assume that the members of the Special Committee on Science Policy have had an opportunity to read our brief—its brevity is dictated by our compassion for the senators...

The Chairman: We need it.

Dr. Hodgins: ...and by the engineers' traditional regard for economy. We have tried not to repeat evidence already presented. At this time I want only to underline some special points of emphasis, which seem not to have yet been made to your committee.

The first point is that there has been a general tendency throughout the long course of these hearings, to assume that the phrase "science policy" does mean "science and engineering policy". While this is almost certainly the intention of this committee, almost all of the briefs have been constructed on the assumption that a single policy, usually consistent with science, rather than engineering, will be appropriate to both jurisdictions. Indeed, some of the graphs with which you have been supplied, do not separate the disciplines, a practice which fosters the danger of incorrect generalization. The fact that we may have large doctoral classes in chemistry and theoretical physics should not prompt us to curtail enrolments in mechanical engineering or metallurgy. The disciplines must be examined separately.

The second point of emphasis I want to make is to follow up the point already hinted at, that the same policies are not applicable equally to science and engineering in Canada, for at least two reasons. For one thing, the motivations of these disciplines are entirely different, and this difference must be preserved, for the good of each. Pure science should be as unstructured as possible, if it is to flourish, while engineering is by definition the application and synthesis of scientific knowledge, to the solution of some of the problems of life. Engineering policy must to some extent reflect the focus of concern over real problems of this country.

There is another difference—one of timing. While Canadian science is topical, and reflects global progress as in science, Canadian engineering is considerably out of phase with other developed nations. The quickening of the pulse of secondary industry in Canada is about 12 years behind the similar phenomenon in the United States. Our graduate schools in engineering—I am not talking about the sophistication of the techniques that are being used but about the slope of the curve of increase of technological industry in this country—are probably 10 or 12 years behind those of the United States. Our graduate schools in engineering in this country are only recently of significant size—650 graduate students in 1958, 3,650 in 1968.

The Chairman: It is strange, sir, it is more or less the same lag we have in the standard of living.

Dr. Hodgins: Yes, I think they are related. This lag represents a splendid opportunity to learn from previous example of success and failure, if we are really alert to it. Our science policy must take into account this opportunity presented by the lag.

I have made these remarks in the hope that they will stimulate some serious discussion of the differences, rather than the resemblances between science and engineering. These differences must be taken into account in the development of science policy, because a uniform amorphous, science policy is likely to do a disservice to both science and engineering. We must nurture, and not coalesce them. Vive la différence! Thank you.

The Chairman: Mr. Templeton, I understand that you speak on behalf of the Association of Consulting Engineers of Canada and also the Association of Professional Engineers of the Province of Manitoba.

Mr. Carson H. Templeton, President, Association of Consulting Engineers of Canada and Member of the Association of Professional Engineers of the Province of Manitoba: Mr. Chairman and honourable senators, I would like to speak first on behalf of the Association of Consulting Engineers of Canada, which is a group of consulting engineers employing some 17,800 technical personnel. These are not all engineers; many are in other disciplines. We would like, of course, to demonstrate the capabilities in Canada of this floating force available to all industry, Government and various segments of the community and stress, although we do not do pure research, that one of the ways in which we feel that we can contribute to the community in addition to what we are doing now is to do some very specific applied research and development. This requires not only being able to do it ourselves, but having the co-operation of Government and industry.

We must recognize, as Marshall McLuhan said, that we are irrevocably involved with and responsible for each other. We find that industry cannot work alone and neither can Government.

The Chairman: That was not one of his most original discoveries.

Mr. Templeton: We are trying to develop within the consulting engineering profession

an interdisciplinary approach, which I think we all agree is absolutely necessary. We feel that we also need an inter-organizational approach, and we also feel very strongly that in the past we have not been sufficiently integrated with Government, universities and industry to be able to make a proper input. We think that each segment of our scientific community tends to stay in its own little corner and not stimulate the other.

The universities can do a great deal in this regard and we, of course, realize that we have had a serious problem in trying to staff up for this greatly increased enrolment, but now that we are getting used to this growth we must be stimulated by them in industry and the consultants. We believe that this floating nature in which the consulting engineers are employed, is very valuable to the country and should be stimulated. We think that this is one of the answers to the problems of Canadian firms becoming foreign owned, as a rule. The larger firms are mainly foreign owned, and the research and development is being done in other countries. The smaller firms cannot afford an extensive research and development capability and somehow or another we must provide this. Whether it is through the universities or consultants, I do not know, but it needs to be done, and it has to be done on a particular basis which can produce an answer very quickly. This separates, to some degree, basic research and perhaps the university type of research and development organization from the consultant who is put in to do a specific job and given a certain number of days and dollars in which to do it.

There are another 50 consulting engineering firms in Canada doing work abroad very successfully, part of which because they are capable and part of which because Canada is well regarded abroad and they do not think that Canada has any ideas of ruling their economy. This has been very successful, and a great deal of work is being done, but competition is extremely fierce in many countries, including France, West Germany, and particularly Italy. They are subsidizing engineering studies abroad to a great degree so that they can get their foot in the door, because an engineer designing a project will usually specify the products with which he is familiar and the products can follow.

The financing is the key to the developing countries and Canada is doing a great deal. Other countries are doing perhaps more.

There are some segments of our industrial development in which Canadian consulting engineers do no participation. This is mainly due to the fact that the segments are foreign-owned. I think it is only normal that companies who are foreign-owned would employ people with whom they are familiar. That does have a serious effect on us, in that we do not have any spinoff from the technology that is developed in this. The petrochemical industry, in the brief, is only one of those, but there are very few petrochemical engineers doing work in Canada.

We do not have the answer to all these problems we are giving you. We only say they are problems. But we feel we could participate in the working out and solution of these problems. Despite Marshall McLuhan, or where he got the expression, "I think we are responsible for each other." Thank you.

The Chairman: We will hear now from the Association of Professional Engineers of the Province of Manitoba. You will deal with that also, Mr. Templeton.

Mr. Templeton: Mr. Chairman and honourable senators, the Association of Professional Engineers of the Province of Manitoba, due to a misunderstanding, had only a week to prepare the brief, but I do not know whether it would have been longer if they had had more time.

Manitoba is having a very difficult time keeping its technical personnel. I suspect this is true in other provinces. We educate them and the people leave and the association would like to develop the idea that we have in Canada national goals and that these are of a broad nature but before you can achieve those national goals you must also break these down into their components, which could well be regional goals.

We do not say that Manitoba should be subsidized. We really think we should decide, with the federal Government and the Manitoba Government, which are those things which are unique to Manitoba and have the work of research and development and industrial development done in Manitoba which is of particular interest to that province.

In a province like Manitoba we cannot be leaders in a great many fields. We have to stick to the things that are pertinent. I think the Science Council said this in its brief, regarding Canada, that Canada cannot be leaders in everything. This is true. But I do think that we should all try to break up the

national goals into the components by which each region can have an interest.

The Chairman: Thank you. We will hear now from the Engineering Institute of Canada.

Brigadier-General Jean P. Carrière, President, Engineering Institute of Canada: Mr. Chairman and honourable senators, I appear before you as President of the Engineering Institute of Canada. I would like, first of all, to tell you what the Engineering Institute of Canada is. In simple language, it is the only learned society for engineers of all disciplines. It was founded in 1887 as the Canadian Society of Civil Engineers and has existed to this day as a voluntary association of engineers who want to keep up with the times. Its aims and objectives have not changed basically since its foundation. That also can be summarized by saying that its main function is to protect the individual practising engineer against obsolescence by providing all the possible facilities to keep up with the development of the times. Its membership is from right across Canada, in every province and in every field of endeavour connected with engineering.

I would like to leave the description of our brief to the chairman of our committee on engineering research and development, who is with me. The members of the committee are named in the first page of the brief. We have two of these with us today. The chairman, Dr. Richard Quittenton is on my right, and Mr. Southam is sitting in the audience.

On behalf of the institute, I assure you that we have no axe to grind. The action taken on this brief and preceding ones is entirely as a good corporate citizen, or an association, or as good citizens, and as an individual. May I ask Dr. Quittenton to deal with the technical part.

Dr. Richard C. Quittenton, Chairman, Engineering Research and Development Committee, Engineering Institute of Canada: Monsieur le président, honorables sénateurs, cet insigne, le marteau—the hammer—that is the symbol of my father, the blacksmith. He only needed this tool, which is very simple, a grade 4 education, to make a living for himself and his family, including me, and to play a constructive role in society. That is all he needed.

The Chairman: I might need it.

Dr. Quittenton: Ceci, une fusée, this is the symbol of my son, this rocket. He needs Grade 14, and two years of high school, and a host of complex instruments, a great crowd of highly skilled instruments.

It is because I am concerned about my son and because the engineering institute is also, that I am here today. It is up to you, the senators of Canada, to provide leadership now, to give us the direction to take us into the age of the astronaut, quickly and effectively.

Honourable Senators, we have problems, and I would like to show you this picture, if I may. This is something we call a productivity gap. I suppose you know about it already. This is the difference in the national output per person, man, woman and child, between Canada and the United States, and also between Canada and Sweden.

We must remember that it is the sum of the goods and services of the country that supports us, that pays my salary and maintains this Parliament. We can do nothing if we do not generate, and that is our gross national product.

In 1910, the American only produced \$62 more worth of goods and services than the Canadians; but by 1948 the American was producing \$1400 more worth. If you project this curve, you find that by the year 2000—and this is only 30 years away—he will be producing \$3,000 more.

You can say, "who cares". Now, \$1,400 is the price of a coloured television set and a second car. That is what the American workers have now, and what many Canadian workers feel they should have—particularly in Windsor, where I come from.

Like everyone else, we in Windsor are very close to the American border and we see these things. We all speak the same language. I would feel more secure nationally if we all spoke French and lived in the Edmonton district. This is the kind of underlying economic feature we have to deal with in Canada. We must remember that this difference in income provides the difference in the standard of living between the two countries, but also provides the incentive and the desire of Canadians to have a similar standard of living, even though perhaps we cannot afford it.

The second problem, and indeed it is related to this, is our unemployment picture. For the last 18 years it has averaged 4.6 of the labour force. For the last ten years it has

been 5.2 of the labour force. It seems logical that you can predict up to 1980 that it will run around 5 per cent or even 4.8, and we have projected that figure.

If you do that, using our population figures, you will find that there will be about half a million Canadians unemployed in ten years. That is a lot of Canadians.

If you couple that with the difference in our national productivity, I believe you will realize that we are facing some rather unique sociological and economic stresses.

Now, the institute has studied these as best it could and has come up with a series of findings. These are simply some taken from our report—what we feel are the more important ones.

First of all there is the productivity gap which has been worsening for 50 years. Then there is the unemployment problem.

Another thing we did, when we started this study, was to make a survey of all our industrial leaders in Canada, because we felt that since this was a national problem, a production problem, we should go to the corporate presidents to get their comments and points of view. We had about 80 replies to our inquiries.

Summing this up, we found that the industrial leaders who supply jobs to support our productivity feel that transportation is a national project of first importance to this country. They also feel that we need more incentive for the innovative processes to support our productivity.

We also found that, oddly enough, despite this area of large corporations, an invention is still sparked in the single brain, and the small man, the inventor, the entrepreneur, is still making a large part of the discoveries which lead to the innovative process.

We also found that our governmental organizations, the National Research Council and Defence Research Board, have been more successful in the commercialization of their ideas in transportation and electronic instrumentation than in any other areas.

So, based on this background, we are making the following major recommendations to you, our senators. There are others but these are just the key recommendations. We recommend that preference be given to national objectives of a job-generating nature, because of this problem of employment and because, if we have good employment, we can pick off

tax dollars to support social problems but, if we don't have the tax dollars coming in, there is no way we can pour the money into social objectives like improving urban blight and pollution.

First of all, we must see that Canada can move into the age of the astronaut from a strong industrial base. We recommend, therefore, that two major national objectives be implemented, one in transportation, which is of primary importance, and one in computer technology which we are stressing because of its pervading influence all through science and technology and also because it can be a powerful tool for the service industries.

Who has come here to speak for the service industries? Very few, I suspect. Yet they are producing 60 per cent of our employment. Someone has to think and talk about this sector of our economy. This is part of the reason for our pushing a program in the computer field.

We recommend a Small Inventors Act to find and support the small, private inventor, entrepreneur, on some kind of guaranteed loan basis to get him started. We are not talking about companies but about individuals. We are talking about the basement inventor, the man who invented Polaroid and Xerox—and they were invented in the basement. We are concerned with the inventions that come out of the bathtub. We have to find and support these. Canada needs these more than any other country in the world, because a lot of our productive capacity is linked to ownership elsewhere. That is one part.

Secondly, we find that Canadian industry as a whole is not, for one reason or another, devoting the same proportion of the amount of its resources to this innovative process as other countries. It seems to us that we must somehow find this small man, if we can get to him, and give him this support, because he at least can be creative.

We are also recommending a three-year tax abatement on discoveries and inventions in Canada. After all, what is the difference between a new manufacturing discovery and a new geological discovery? And yet the latter has a tax abatement and an obsolescent factor; but a new idea becomes obsolescent faster than a mine operation, quite often. These new ideas are the things that create jobs. Therefore, it seems to us that it is equitable and necessary to our survival to support the innovative process. If a new mine can generate a whole new town, part of which is

based on their three-year tax abatement, then, perhaps, developing a new process in a new plant has similar value.

I will just close by coming back to the first statement. That is what the productivity gap means in terms of bread and butter. In 1810 the Americans produced 1,400 pounds more bread and butter than we did. By 1968 they were producing 7,000 pounds more. It is such comparisons that lead many Canadians to press for the same standards as the people in the United States have, but the fact is we are not producing the same amount of bread and butter.

As part of our effort to support the bread and butter output, we give very serious consideration to the innovative process, and we are making very specific recommendations to support this process. Thank you.

Senator Carter: Mr. Chairman, there was a 1,400 pound gap shown on that graph. The brief says that they are in market dollars, however. Does that not distort your picture somewhat?

Dr. Quittenton: Yes, sir, and this is why I put the bread and butter in at the end. The bread and butter is the bread produced at the price produced in that year. You will note the gap in pounds of bread is not as wide as the gap in dollars, but the gap has still increased, sir. Do you follow me?

Senator Carter: Yes, but you can pick one commodity and make an argument and pick another commodity and make a different argument.

Dr. Quittenton: Well, I did take milk, and I could have taken automobiles. The gap would have been just as wide if I had taken automobiles, because the price of a car in 1910 was \$2,100 and you could buy a car in 1968 for \$2,000.

Senator Carter: If these dollar figures were given as constants, what would the comparison look like then?

Dr. Quittenton: It would be just about the same. The relative inflationary pressures in the two countries have been somewhat uniform.

Senator Carter: In 1949, when I came to Parliament, the Canadian dollar was worth 10 per cent more than the American dollar. The situation is now reversed.

Dr. Quittenton: The calculations are all brought to U.S. dollars. They have fluctuated

up and down over the 50 years, but the fact remains that in terms of national output per goods per hours of work, the gap has increased over the 60 years.

Senator Carter: I know that the gap is increasing, but I wonder if there is not some exaggeration when that type of graph is used.

Dr. Quittenton: You could be right.

The Chairman: Not necessarily, when you compare the two countries where, as was indicated, the cost of living has been increasing at about the same rate.

Senator Carter: Dr. Hodgins, with respect to the comparative figures you give on page 6 of your brief, are you suggesting that Canada is putting too much money into basic research?

Dr. Hodgins: No, sir.

Senator Carter: And not enough into development.

Dr. Hodgins: What I am saying is that we are not putting enough into development.

Senator Carter: But, if you are not going to increase your percentage, what is the situation?

Dr. Hodgins: You can change the proportions without changing the absolute amounts unless you are going to spend the same amount of money.

Senator Carter: Well, the amount is fixed and we have a limited amount to start out with.

Dr. Hodgins: You have a limited amount of federal money. It is a well known fact that industry is not putting as much money into development processes in Canada as it is in the United States. So that money would be private money. The deficit shown in development research is largely in the industry of the country. I am not suggesting the ratio between basic research in Canada and the United States is necessarily wrong, because if I were to do so I would completely alienate every science friend I have in the country. The point I am making is that almost exclusively up to now in these hearings science has been tacitly assumed to mean science plus engineering, and yet almost always the talk has been about science. These figures were taken out of a table already submitted by one of the witnesses to this committee. What I am

really just saying is that the engineering deficit is largely in the area of development.

Senator Carter: In the area of development and also in the industrial sector.

Dr. Hodgins: That is correct.

Senator Carter: But how can you develop a science policy to correct that imbalance? You do not see very much more coming from the public sector, but if this is where the deficiency is, how can we develop a science policy that will overcome that?

Dr. Hodgins: I am an eternal optimist about Canada. Canada has always met the challenges with which she was presented; she always met them—although at times she may have been a little late. Nevertheless she always met them and I do not believe that this country will do anything but swing into vigorous development of secondary industry. If we are going to compete in world markets, which are very abrasive, there will have to be development if we are, so to speak, to get the cream off the top of the bottle. The great profits of Xerox have been mentioned but they have been accumulated in the early stages of development before the competition got into its stride. Canada will meet the challenge, and even now we are entering the era that the United States entered in 1957. The money will be made available by industry if they want to stay in business, and if Canada is to succeed in world markets it must get into entrepreneurial innovative activities in secondary industry.

Senator Carter: The point has been made that in Canada we have many subsidiaries of U.S. industries and since the major research is done in the United States we do not get the benefit of innovation and our purely Canadian industries are too small to have any great facilities of their own. How are we going to overcome that?

Dr. Hodgins: In some cases we are starting already. There are certain industries in this country getting into entrepreneurial activity very vigorously. We have one here in Ottawa, or at least in the Ottawa area. Is it in order to mention the name of the firm or is this like television?

The Chairman: It is quite alright to mention it.

Dr. Hodgins: The Lee instrument company is a very good example of what I am saying, and any senator who has stock in the Lee

company I am sure is delighted with the increase in their innovative activity. It involved a capital gain of about 45 per cent, which of course is free of capital gains tax, in the last 12 months. This is a case in point which represented some federal support to IRAP programs under the National Research Council which jelled into real hardware, and so they made a substantial gain. These companies are starting to do this in Canada now.

Some of the universities, my own included, have formed industrial research institutes with support from the federal Department of Industry. Like any new enterprise, you have to shuffle for your work, but these are proving to be a very effective way of entering into communication with industry. So when small industries in Canada, and there are many, avail of these facilities, they will show a big gain. Mr. Templeton is completely right. We do not get the scope from large industries because they have their own laboratories or because they are buying their research offshore or in the United States. But the small industries do not have the spectrum of talent necessary for broad innovative activity and so they can go to an industrial research institute at a university where they are faced with a complete spectrum ranging from abstruse physics to hard-nosed designers. They have available to them, for example, the technologically-based disciplines on one hand and the sociologically-based disciplines on the other. This allows a small industry with some government support to come to such an on-campus institute and to avail itself of the broad spectrum of personnel which only a university has at the moment, and to do innovative work which at the present time it cannot possibly afford on its own premises. I think that is how it will go and I am completely convinced that that is the route by which this type of development in innovative work can proceed.

Senator Grosart: If I may ask a supplementary question arising out of that, could you comment on the fact that the evidence we had from the Provincial Industrial Research Institutes is to the effect that nearly all of their customers from the industrial sector were big firms. They were very discouraged at the lack of research activity entrusted to them by small firms.

Dr. Hodgins: I cannot really, senator. Our experience is the inverse of that.

Senator Grosart: Secondly, on the same point, the Bell Telephone stated that their

corporate investment in R & D annually in Canada is \$50 million. They made the surprising statement that \$41 million of that total is indigenous and only \$9 million was for imported R & D. Is that applicable generally in industrial R & D in Canada?

Dr. Quittenton: Well, I have to go by what he said.

Senator Grosart: This is very encouraging, if it is true. Now if 2/3 of our manufacturing industries are subsidiaries of United States industries, how do these figures stand up?

Dr. Quittenton: Well, the bulk of Bell R & D in Canada is done by Northern Electric, and I believe Northern Electric have the largest R & D establishment in Canada. That figure could well be right. I have no way of checking it, but that is what he told me, and he is a responsible executive, and I have to accept it.

The Chairman: This would be just in line with the conclusion of the Watkins Report, that in general, the American subsidiaries tend to do more research, everything being equal, than their Canadian counterparts in Canada.

Dr. Quittenton: May I speak in response to Senator Carter's comments? I am not quite as optimistic as Dean Hodgins, that we will just evolve out of this in due course. I believe that the Canadian character requires a little more prodding—it seems to be that way, anyway—and this is why we are suggesting some specific ideas, to deal with your point, Senator Carter. Dean Hodgins mentioned Leigh Instruments; and that is a specific example of the kind of thing we are trying to promote. This has grown from a small outfit and is now one of the large ones, supporting many people and competing internationally. That is the kind of fellow we have to find, because we can no longer wait on subsidiaries of foreign companies to develop our country faster, and it has to pick up the half a million jobs. So we say serious consideration should be given to helping these little people, like Leigh Instruments, to start, and that they should be helped early, they should be got on their feet early, with something like a Small Inventors Act, and at the same time to give them impetus because it seems to be a characteristic of this country that we cannot find them and assist them in this way, and we should do something about it. Maybe we need a little more help, and we are suggesting a three-year tax write-off for new products

invented and developed in Canada. This is our suggestion.

Senator Carter: And I think it is a good proposal. I have known dozens of cases where ordinary Joes, without any great technical training, have come up with marvelous ideas. I was talking to a fellow not so long ago who invented a method of constructing buildings in a metal framework in such a way that you could erect and take them down quickly and move them from one location to another. He tried all around Canada to get somebody interested and to help, but he had to go to the United States, and that is where he is now.

Dr. Quittenton: I was speaking to an American banker once, and he said that one of the differences was that the financial people down there, particularly in cities like Boston and so on, would always be in the innovative centres in the universities talking to the people on the bench, so there is intense rapport between some of the people hopefully coming up with ideas and the financial sources. We do not have that in Canada.

The Chairman: We have it, but it does not work.

Dr. Quittenton: Well, anyway, we are suggesting that somehow, if that concept is accepted, we work it through the financial institutions and not through any governmental agency.

Senator Carter: I would like to follow up with one last question of Dr. Hodgins on invention. In the short term, you say, we are getting around the bend, but it may take a few years. Do you think we should do more of what Japan has done and take the basic research and ideas that have been developed in other countries?

Dr. Hodgins: I cannot think of anything that would bolster the Canadian economy more quickly than that. There are perhaps two points in our brief. One is that the figures which were provided to this committee by NRC showed where the concentration of people who should at least be innovative was. If a Ph.D. is by any means a measure of innovation—I am not certain it is, but if it is, 70 per cent of the Ph.D.'s in this country are located in the universities. I think we have to go back to the point we tried to make in the brief of the Deans of Engineering, and that is that it is a relatively new task force, one that has gone up by a factor of six since 1968, and it is relatively raw. It has at least two charac-

teristics. One is that it is of relatively recent origin and while it is settling down there is an enormous amount of diversity because every man coming first into the university feels that his only mission in life is to proceed with the work on which he did his Ph.D.; he has not had a broad enough vision yet.

Secondly, in assembling task forces of this size so quickly, we have in the universities of Canada a group of people who have relatively short industrial experience. The proportion of young university men in engineering who have an industrial background is quite low. This situation will change and they will develop such experience on industrial sabbaticals and as some of these new policies go into effect. However, there is no question at all but that the task force is here, and we have to switch the focus on that task force. I think the place where that focus should be brought quickest to bear is the engineering schools. We need pure scientists in this country who pursue research for the purpose of adding to the information bank in the world. We must protect pure science in Canada and allow it to flourish in a relatively unrestricted way, but the place where some focus is probably overdue—I do not think it is terribly overdue but our task force of engineering innovators of sophistication is pretty recent. So we have to try to evolve a policy which will allow that focus to switch, to some extent, in this country. I agree to some extent that they must be in the area of secondary industry, where we can make profits from innovation.

General Carrière: We could illustrate it with a table from our original brief of two years ago.

The Chairman: Is it true, what we are being told, that the pure scientist and the engineer live two parallel lives, or, at least, tend to live two parallel lives, in the sense there is little communication between the two? The pure scientist has some kind of contempt for the engineer, and the engineer does not read the stuff produced by the scientist?

Dr. Hodgins: No, I am sorry if I have given the wrong implication.

The Chairman: It is not your implication, but we were told this by other people, including the people we visited in Boston, that engineers were not great readers of scientific material.

Mr. Templeton: I do not think this is true today.

Dr. Hodgins: To whatever extent it is true, I think it is probably true that scientists are less avid readers of engineering material than the reverse, because the engineer cannot live without reading scientific material, but the scientist can live without reading engineering material. I think there is a good inter-mesh. I came here directly from a mixed conference between the Department of Chemical Engineering and the Department of Chemistry, with a mixed group of speakers on catalysis. I think the recent character of our engineering task force is the key to this sector. I would like to show you a slide which illustrates our suggestions in respect of trying to implement this, and to indicate that in fact something is happening about it.

Dr. Quittenton: Dean Hodgins is saying that while our output is increasing it is not increasing fast enough in the engineering sector. These are figures of the output of Ph.D's per million of population as of 1966-67, and the numbers per million have been pretty low. By 1970 this is doubling, but the output of physical scientists is relatively enormous. You will see that we are away behind the United States in the output of engineers. We are not catching up with them. Even by 1975 we are producing less than half. On the other hand, we are well up in respect of the physical sciences. In fact, according to this chart, we are well ahead of them. The big difference is that this figure here includes the bio-scientists, and I think that that is an equivalent number, so if you double that you get the output of physical scientists. We are doing not badly in respect of physical scientists, although there may be a feeling that we are turning out too many zoologists. But, in terms of engineers, we are still slow.

There is one comment I should make, and that is that there is a broad mingling between the engineers and the scientists in the industrial sector. I feel also that because of past history in Canada—which may be changing now—the engineering faculties in order to establish prestige and to obtain grants have become science-oriented. There are some sciences that are changing, but that has been the record in the past. So, I think there is some substance to your statement, Mr. Chairman.

Senator Phillips (Prince): I should like to ask you, Dr. Quittenton, whether there is an organization to which a person with an invention can turn for refinement and perhaps marketing assistance.

Dr. Quittenton: In Canada?

Senator Phillips (Prince): Yes.

Dr. Quittenton: There is no organization that provides that service as such, but there are some private enterprise groups which will supply venture capital for new ideas, but these people require that the idea be relatively well advanced.

In the Government there is nothing. You must be a company that will put up at least half of the cost in order to get a NRC grant, and if you want a Department of Industry grant you have to put up three-quarters of the cost. So, the answer to your question is: No.

Senator Phillips (Prince): I am thinking of a fellow who patented an idea back in 1941 which was never refined or developed, and then the patent expired. It took the engineers a lot of time to catch up on this. A lot of time was wasted because the idea was patented, and the patentee really did not know how to utilize the patent.

Dr. Quittenton: We have no mechanism for stimulating that.

Senator Phillips (Prince): I congratulate you for emphasizing the fact that there should be more research in transportation. What aspect of transportation do you have in mind?

Dr. Quittenton: We have made some very extensive recommendations, and we have broken them down into several different areas. On page 4 of our brief we mention special purpose aircraft such as the short and vertical take-off aircraft. We are recommending this because if we are going to go into the north country the quickest and simplest way of getting there is via the air. None of the centres in the north can afford a large and expensive airport of the kind we have in southern Canada. The virtue of these types of aircraft is that they do not need expensive airports.

Furthermore, the aircraft manufacturing industry in Montreal has demonstrated already a skill in producing and designing special purpose aircraft. So, this is something that seems to be made to order for Canada. We recommend programs in respect of special purpose aircraft because we have the skills and the need.

We are suggesting that a major portion of the philosophy of the transportation project

be devoted to the service industry—that vastly neglected area of our economy which takes up 60 per cent of our production and our jobs.

The Chairman: How can we specialize in the area of computers so as to be in a position to really contribute something which would be different from what the Americans are doing on a much larger scale?

General Carrière: This is in reference to software, and not hardware.

Dr. Quittenton: The Americans are the experts and world leaders in developing the box itself—the hardware, the computer, the nuts and bolts that go inside the computer in which we store the information—but the work at the interface of the computer between the machine and the man, the so-called software side or the interface side, is still virtually unexplored, and it is open to the whole world. We are suggesting that this is an area for Canada to concentrate on. There are some specific sides to that in respect of which we must have a special incentive to do something.

No, we should not try to compete with the Americans on the hardware side, but we must try to compete with them on the software side.

General Carrière: And we can.

Dr. Quittenton: Yes, we can. In the resource industries more attention might be given to solids pipelining and electric power transmission as part of our transportation project. For example, it has been found that if you drive heavy equipment in the winter time over the northern muskeg deep throughs eventually develop and fill with water. It has been found also that if you take a cable and run liquid nitrogen through it you can get super conductivity, and you can transmit electrical power at much less cost than in the conventional manner by means of towers. We might have a system of muskeg canals all through the north serving as transportation routes, and also containing submerged superconducting cables.

Dr. Hodgins: Just so that our scientist friends will not have an opportunity to clobber us, I would point out that you are referring to liquid helium and not liquid nitrogen.

Dr. Quittenton: Yes, that is right. It is a difference of ten degrees, I think, and that is important.

Special attention should be given to the ice problem—to transportation over, under and through the ice. There should be special attention given to northern development in the area of transportation, and this should be guided into defined areas, but the program must be co-ordinated from somewhere. As Dr. Hodgins notes, transportation is being tackled by six or eight different groups across the country, and nobody seems to know what the other person is doing.

Senator Robichaud: What about road transportation, which is the most costly today for all governments, particularly on account of frost damage in the winter.

The Chairman: The hovercraft will take care of that. We will get rid of the wheel.

Senator Carter: I would like to ask a supplementary question here. You have spoken about the ice. Are you familiar with a type of plow that can be installed on the bow of a ship to plow up the ice?

Dr. Quittenton: I know roughly of it.

Senator Carter: Are you impressed with that? Are there possibilities in it?

Dr. Quittenton: I have not seen it personally and only know what I have read in the newspapers. It seems to be a new concept. It would be wonderful if you could put this sort of thing on a submarine and maybe get a dual purpose out of it.

Senator Carter: I was wondering if you had in mind, when referring to submarines, that we should try to develop a new design of submarine for underwater transportation of cargo.

Dr. Quittenton: One has to decide whether the problems are important enough to do something about them. Take the Ungava region of Quebec where they are trying to develop nickle and asbestos. They have about a two months' shipping period and have to stockpile for ten months because the water freezes up solid. In Baffin Island there are apparently the largest iron ore deposits in the world; it is 60 per cent iron; there is nothing else like it in the world. How do you get it out? They are frozen up for 11 months of the year. If this sort of thing is considered important to the national economy thought must be given to what is limiting it. Transportation under the ice may be one limiting factor. Reference is made to oceanography and Canada having one of the longest shorelines in the

world, some of which is frozen all year round. It seems to me that before getting involved in oceanography we had better develop some techniques for handling ice first, and maybe the underice suggestion is one way.

Senator Carter: I was thinking of wheat going up to Hudson Bay in a pipeline and getting on plough ships.

Dr. Quittenton: Agreed.

The Chairman: Senator Grosart, did you want to ask a question on transportation? I think Dr. Hodgins would like to say something.

Senator Grosart: I have some questions I would like to ask about national science policy.

The Chairman: I think this is related to it, because before we try to get a policy it is important, it seems to me, also to investigate the problems that should be the subject matter of science policy. Dr. Hodgins, would you like to make your comments?

Dr. Hodgins: This may assuage Senator Grosart, because it has to do with science policy. I think the best thing I can do is to read this from the brief, because it is a more cogent way of doing it than by the impromptu method.

Talking about transportation we say that as a corollary to the previous recommendation in this report it is important that relatively early action be taken to provide central coordination for the research undertaken on the priority problems. Taking, as an example, the Canadian transportation problem, there are already at least six agencies at various levels of government declaring their involvement, irrespective of their qualifications for the job. Herein lie the seeds of mediocrity—too many uncoordinated and relatively unsophisticated research designs, too much overlapping, too many gaps and not enough horizon-to-horizon vision. Transportation has an enormous impact on the Canadian way of life; it demands a massive systems analysis, and research coordinated so that the flowlines are most efficiently established for municipal, provincial and federal needs.

I really think the transportation problem in Canada is just that. It requires a monstrous systems analysis to determine the flowlines in this country, the ones that are critical and the ones that are subcritical. This can only be

done by optimizing the efforts of the meagre supply of personnel available for this study—and it is very thin indeed. Anything less than a clearly identified institute (which might be an institute stretching across several agencies in the country) will be ineffectual—that is a single institute for transportation—in exploiting the enormous opportunities in such a national priority problem. A very high percentage of our tax dollar goes in this way. I see this as part of the national science policy.

Senator Grosart: My concern is how it becomes a function of national science policy from the point of view of the federal Government, because from the evidence we have had it seems fairly obvious that the biggest single problem area is the funding of R & D in industry, from both the funding and performing points of view. From the evidence we have, this seems to be our biggest deficit. Where does the responsibility lie? Who is responsible for the imbalance of the past? Is it the Government or is it Canadian management?

Some of the evidence before us seems to be extremely critical of Canadian management, yet if we look at the responses to your survey they seem like the most dedicated, intelligent people in the world in their responses. They do not all agree with one another. Is Canadian management falling down on the job to the extent that some of these briefs this morning indicate? In your own brief we read:

Canadian management has been astonishingly slow to read the lessons about industrial research and development which abound all around us—in the United States, Sweden, Italy, Germany and particularly in Japan.

Later on you say that the keystone of national science policy is “the cultivation of the right kind of Canadian management”.

Dr. Hodgins: Yes, sir.

Senator Grosart: This is the keystone of national science policy? What kind of management? Do we fire, get rid of, the head of Bell Telephone and MacMillan Bloedel and all these other companies that have responded, and get new ones? What do we do? The keystone is the incompetence of Canadian management.

Dr. Hodgins: This is the cultivation of Canadian management who understand the potential of the innovative people who are being graduated.

Senator Grosart: Excuse me. Your statement is that Canadian management has been astonishingly slow to read the lessons about industrial research and development.

Dr. Hodgins: Yes, sir, this is right.

Senator Grosart: That is incompetence, if ever I saw a description of it. Anybody who is slow to read lessons is, I think you will agree as an academic, pretty incompetent.

Dr. Quittenton: May I speak to that, perhaps in defence of management? I have talked glibly about productivity. People have asked me what it is all about so I have had to sit back and do a little thinking. It is not an easy question to answer. Nowhere in, for example, the Economic Council reports do they tell you what governs productivity. People point to the effect of management. I have done it myself quite readily. I have therefore had to sit down and examine what are some of the factors involved in productivity. I have some here on a slide.

The first one is a much smaller market size and consequent shorter production runs with proportionately higher costs for plants and overheads. Secondly, we have a less well educated management and work force. The average American has almost two years more education than the Canadian. This does not mean that management is incompetent; it just means it is not as effectively trained at the moment.

Senator Grosart: They have been slow to read this lesson you are going to give us.

Dr. Hodgins: Sure.

Dr. Quittenton: We have more people unemployed therefore our output is less. This is another Canadian characteristic, that we have a very conservative investment philosophy. This is linked with management. For some reason we all like life insurance. Statistics show that we have the largest coverage in the world. Number five says that we have a much higher proportion of foreign ownership of production assets, and also the highest level in the developed world.

Senator Grosart: I want to come back to number five. The Bell Telephone gave us a ratio of four to one of indigenous funding of R and D in their company. What would be, as a guess, the comparative percentage across the whole field of industrial investment in R and D in Canada with the four to one ratio

of the Bell Telephone. Would it level out across the whole spectrum?

Dr. Quittenton: I believe that is the ratio, the money they spend in Canada versus the money they import.

Senator Grosart: This is, of course, one of the most essential components of the problem on the evidence we have here. Is this Bell Telephone figure anywhere comparative?

General Carrière: I have not got the statistics, but I think Bell Telephone would be high in the particular research compared to the average industry in Canada.

Senator Grosart: The reason I raise this question is that it is important, both positively and negatively. It is so positive because if we have a "free" input from the United States, leaving aside any qualifications one might make, it is a good thing. The negative aspect is that "leased" R and D has very distinct disadvantages from the point of view of any nation.

General Carrière: If we are to be exporters we cannot be imitators.

Senator Grosart: I hope we might hear something really specific about the Japanese. One of the references here to the unheard lesson is Japan. The others are the United States, Sweden, Italy and Germany. I should hope somebody might comment on the specific lessons these countries can teach us. We have heard a great deal about Japan.

General Carrière: That is an old fashioned idea which I do not hold today. Japan may have been imitators before the last world war, but it learned its lesson quickly.

Senator Grosart: What is the lesson we should learn from Japan, which has managed to build up a tremendous industrial establishment and tremendous export markets without the kind of degree of foreign control of industry we have in Canada?

Mr. Templeton: The Japanese do not work alone. If one segment of the industry learns something, that knowledge is available to everybody, whereas we tend to keep our patents in our pocket and do not tell our competitors. Everything in Japan is available to all Japanese industry. They have, through sheer force of effort, done things that the United States has taken a great deal longer to do.

Senator Grosart: Should this patent policy be part of our national science policy, in line with the drug bill, as far as patents are concerned?

Mr. Templeton: I think we must do something like that if we are going to compete in the world market.

Senator Grosart: Will industry scream as loudly as the drug industry?

General Carrière: They will at the start until they see the benefit of it.

Senator Grosart: I am delighted to have that answer.

The Chairman: That is the first kind of optimistic view we have had.

Dr. Quittenton: I do not think it is unanimous. I do not share that view, and I am not so sure that your statement about Japan is a statement of fact. Japan has strong patents. I was in Japan for two months. It is true they have intercorporate mingling. This is because they have three or four extremely large conglomerates in Japan. I think we have to be careful that we are not involving conglomerates which can, in effect, exchange technical information within the family and people competing. I have a suspicion that the two automobile companies in Japan do not exchange techniques.

Mr. Templeton: I think this is true. I perhaps should qualify my statement. I am quite sure they share their knowledge about nuclear development, but I do not know whether that applies to automobiles.

Dr. Quittenton: We have to be careful as to what we are striving for. I believe one of our possible hopes is the small inventor, and I qualify myself as a small inventor. Frankly, I do not have a great deal of interest busting my neck to come up with a new scheme in development if I give it away to everybody. That is what complete lack of patent protection implies. This means that somebody who has a few more resources than you can capitalize on your work and you end up holding the bag. I am a patent man; I believe it stimulates the incentive process. I also believe nothing has been proven yet to surpass individual incentive in developing social and economic benefits.

Senator Robichaud: I would like to come back to your chart, Dr. Quittenton, and the first part referring to low productivity. It

read something like this: limited market resulting in shorter runs and higher costs for overhead. Is this not one of the main factors affecting our Atlantic provinces today? Is not one of the reasons we have problems due to this particular fact that our secondary industries are operating for a short period and still have a very high overhead in maintenance? It seems to me this could be one of the main factors.

General Carrière: It is a factor, senator, because in the Atlantic provinces you are producing things that are produced elsewhere and, therefore, you are producing for a limited market. If you had innovations and you were producing things that are not produced elsewhere, even in Canada, you would have a broader market, longer runs, and a lower proportionate overhead. This is reducing the thing to its simple terms.

As I said a minute ago, you cannot be an exporter and an importer at the same time. This is where the innovative process plays its part.

The Chairman: The Japanese imitators have been imitators of development work. They have been successful, not because they were imitators of innovation. They innovated themselves.

General Carrière: They are the only ones that can build big ships today.

Senator Grosart: I have a few more science policy questions, Mr. Chairman.

The Chairman: Do not be too difficult this morning.

Senator Grosart: I am not being difficult. If I am, I blame the chemists and the physicists. They kept me up late last night. There seem to be two views expressed in the responses to the Engineering Institute Survey about the Department of Industry, Trade and Commerce programs such as PAIT, IRDIA, DIPP, and so on.

One of your respondents says they must be carried on, another says they must be washed out completely. This is part of our existing national science policy. Who is right? These are new policies that have been developed after very deep and long and careful consideration and consultation with industry. I do not want to be in the position of defending everything the present Government does, but I cite these things as facts.

The Chairman: Especially not this morning.

Senator Grosart: Surely, in the area of national science policy, we should get some kind of consensus or response that these programs are no good or that they are good and we should carry on.

In other words, in developing national science policy in the Department of Industry, Trade and Commerce, do they need to read someone else's lessons, too?

Dr. Hodgins: There may be industrialists in this room who may have views on this. I am a member of the National Research Council Advisory Committee on Applied and Engineering applied research. We have a good deal of concern at the moment with the support policy. To answer your question, Senator Grosart, the dissatisfaction stems not so much from the policy as from the execution of it. The industry's long waits for rebates on some of the Department of Industry, Trade and Commerce support programs seems to be the prevalent source of dissatisfaction. It is the long waits for the rebates on the programs. Some of these rebates, as you know, are retrospective. Whereas, the IRAP, the Industrial Research Assistance Program of the NRC, is instantaneous and it seems to generate a lot more enthusiasm.

The Chairman: It is not a rebate: it is a grant.

Dr. Hodgins: The industry are finding that the execution of the program is what is bothering them, not the philosophy.

Senator Grosart: In broader terms, I was asking, is this the right way to go? Take the kind of incentive program comments by Molson Industries, at page 18 of the addendum to the EIC brief. They recommend cancellation of all these incentive plans, and their replacement with tax incentives or low interest loans. All I am asking about is the national science policy. This is a new component of it. Is it going the right way?

Dr. Quittenton: I do not think it can give you a guaranteed answer right or wrong. Everyone has to make up his own opinion for a very serious question like that and obviously our people across the country do not have a unanimous view.

Senator Grosart: No, no, excuse me, the science policy decision-maker in the final analysis to have a unanimous view, even if it is only one man's. He has to come up and say, this is this year's national science policy for \$1 billion of public funds.

Dr. Quittenton: We have come to this conclusion in the institute, in this brief.

The present policies are giving the same benefit. I think that is reasonably clear, as some of the respondents have said. It is giving the same benefit. Other respondents say it does not suit their particular environment.

We are suggesting that, since the present policy suits some people, it should be carried on; but since it does not suit some other people, it should be supplemented. We are suggesting supplementing it with the Small Inventors Act and a system of tax abatements for profits from new inventions discovered and worked in Canada. This kind of incentive is in the minds of people like the president of Stelco and Molsons Limited.

They would incentives for performance. They say, let us give them. They ask, why should a new mine get a rebate and a new plant does not. These are suggestions.

Senator Grosart: Do you generally, or any of the witnesses here, think that far more emphasis should be placed on tax incentives?

Dr. Quittenton: Amen! I think there would be unanimous agreement from the Canadian Association Manufacturers, the chambers of commerce and all industries on that.

Senator Grosart: This points out a great difficulty in the formulation of national science policy. Who is going to decide this? The Minister of Finance may have a different view.

General Carrière: It does not reduce his revenue, because if the innovation that is to be done and get a tax rebate does not exist, he is not going to get money on it. When it comes to the test, if the minister gives the tax incentive for two or three years, he knows then he is going to collect, but if that does not exist, he will not get any money.

The Chairman: When it is attached to invention.

General Carrière: Yes.

The Chairman: But when it is granted for any kind of expenditure on research and development, whether successful or not, then he would lose.

General Carrière: I do not think we would want it to that extent.

Dr. Quittenton: It should be more for performance. That might bring out this Canadian

character, by giving a little push from behind. I agree that we have some people who are very conscientious, but they just require the little bit of additional incentive.

Senator Grosart: This general argument that the Minister of Finance is not going to lose money, and has a chance of making money, applies over the whole field of fiscal and monetary decisions, even to what the deans' brief calls the "vicious" estate taxes in Canada.

It is the same point as some of us have argued, long and loud, that it does not yield very much money net; but the Minister of Finance has other reasons for continuing to impose it. It raises the question as to the extent to which fiscal and monetary policy needs to be brought in line with national science policy.

Dr. Hodgins: But they are elements of science policy. This estate tax is a rather touchy subject because it links incentive to the individual inventor. If he were to flourish as an individual inventor and were to prosper and become head of a sizeable industry, in which in the industrial sense it had become large enough to introduce innovative procedures in the creation of improvements, as soon as he got to be 65 years, he would start to try to decide how to handle his fortunes for his successors. The present policies and estate taxes in Canada have, to a very broad extent, ended in family companies selling to large offshore or United States principals. There is a very long list of these.

The Chairman: That is in order to make a capital gain.

Dr. Hodgins: Yes, so that the families will in fact have something left of the estate.

The Chairman: One possible answer to that would be to have a capital gains tax.

Dr. Hodgins: This is a rather negative answer.

The Chairman: Not from the point of view of the Minister of Finance, it is not negative.

Senator Grosart: I have one other question. I would like to ask, and this is in relation to the statement we have had this morning, and we have had it for a year and a half, of the vast problems of our Canadian nationalism, to which some kind of funding of research and development can contribute a solution. We have had today a phenomenally large list of

fantastically large projects. Somebody spoke, for example, of the iron ore projects on the Arctic shores.

What should national science policy be doing about these problems? There is not enough money in Canada to fund the research and development that would be asked for and that might be necessary to push along all of these things. The obvious comment there is that, if this were part of the United States, the funding would be there. But it is not. So we are faced with a whole series of choices. This is the element of national science policy. How does the decision-maker, the politician, sort out these priorities in terms of support from public funds? How can he sort them out?

Dr. Hodgins: Well, I think the identification of the problem is by far the easiest step.

Senator Grosart: That is my point. There is nothing really easier. A good grade 13 student could write an excellent essay and would not miss very many of the major problems. He could do just what Report 4 of the Science Council did. He could point out the priorities—transportation, urbanization and so on, but that is not really very helpful.

General Carrière: But, Senator Grosart, our first recommendation in our brief is, and I am reading:

Preference be given at this time to National Objectives of a predominantly economic or job-generating nature, as these result in eventual improvements of a social nature.

We start with job-generating programs. I think we cannot, as you say, do everything; nor can we do it all at once. But as a No. 1 objective, we have to look into what brings some benefits to the economy right now. When the economy is better, then we can expand on that.

Now, I have just mentioned our first recommendation. We have put them in pretty much an order of how to proceed.

Senator Grosart: Would you then suggest that it is a function of the national science policy decision to allocate funds by percentages between basic and applied research and development and technological innovation?

Following that up, my point is, how does the political decision-maker translate that recommendation into action? Does he say that there must be a particular percentage of the money going to job-generating research and

development projects? Do you want the Minister of Science Policy, if there is one, to go that far?

Dr. Quittenton: Yes. We put it right in here in one respect. We are suggesting a two-pronged science policy. One prong is the stimulation of the total technological base of the country. And the manpower side of that has been referred to. We are suggesting a stimulation of the total technological base through mission-oriented programs of an economic nature.

That is one prong; that is for long-range, the long pull. This is to strengthen our total base.

For the immediate pull we are suggesting two incentive programs to try to utilize the latent incentive in everybody, namely, a Small Inventors Act and a tax abatement for the innovative process.

Now, for the money, because of the long-range effect of mission-oriented programs on the technological status of the country, we have asked the Government to consider investing \$700 million in these two programs over ten years. Over half of that is for transportation programs; a smaller portion is for the computer program and a smaller portion still will be devoted to financing the Small Inventors Act.

Now, whether it is \$700 million or \$500 million does not really matter, if the Government accepts the concept, and I agree that the Government only has so many dollars to invest. If the Government does accept the concept, then you, sir, and your confreres, will have to make this judgment decision. You are asking us to tell you, but we are only suggesting what we believe, based on the Canadian economy. This figure that you see is only a doubling of the present investment by the Government in industrial research in seven years. It is a tripling in ten years. It sounds like a lot of money, but when you are putting it on that scale, you see that it is only doubling the Governments' investment in industrial research. Moreover, the Government is a 52 per cent partner in all our industry, and it seems to us that perhaps we should be considering this a little harder to support the people who are in effect our partners.

That is our suggestion. We are giving you specific sums and you simply have to integrate that into the national pool. Now, if that requires a diminution of funding in other areas, perhaps that may be needed.

Senator Grosart: You have expressed the problem in exact terms, really: "We are giving you figures; all the decision-maker has to do is to integrate these into the national pool".

Dr. Quittenton: That's right.

Senator Grosart: That is fine, if it happens to be two to one. But it happens to be 200 to one in the recommendations before us now. It is very easy for you to say, "Do as we ask; it only doubles it and that makes sense". Yes, it doubles it in terms of your claims, but not in terms of all the other claims. This is the problem. I don't know how we can solve it.

Dr. Quittenton: Well, you have to look at the over-all picture and decide what is more important. We believe, for the reasons we have given, that our economic stature is most important. Therefore, it seems to us that this is the side that must receive prior consideration. Now, given this prior consideration, if that then involves a diminution, if you like, of current efforts in basic research, then perhaps you have got to make that decision.

Senator Grosart: You are speaking of the pluses of technological development. We have a lot of evidence before us that the priorities should also deal with the negatives—pollution and so on. It is not as simple as you suggest. Somebody else will come along and say that it is much more important to solve the pollution problem or the urbanization problem than it is to move on technologically.

Dr. Quittenton: We are suggesting that in the meantime you may go bankrupt doing that.

Senator Grosart: And according to the other suggestion we may wipe out all our resources.

Mr. Templeton: It could be valuable to us to concentrate on certain aspects of science where we already have a certain expertise and a uniqueness, such as water resources and all the things that flow from that in agriculture, irrigation and recreation facilities, because these things are readily exportable, if they are good enough.

Senator Grosart: Somebody once made the remark that perhaps the direction we should take is to project our policies into a time when we will make our living selling water to the United States.

Mr. Templeton: We can sell our technology right now.

General Carrière: When the need arises for the United States to buy our water, we will not have enough water for ourselves, at the rate things are going now.

Senator Carter: Mr. Chairman, in his opening remarks Dean Hodgins implied that an overall science policy for Canada would not necessarily include a satisfactory engineering policy.

Dr. Hodgins: That is right, sir.

Senator Carter: I would like him to elaborate a little more on that and on what he thinks should be done to make sure that the engineering policy is satisfactory.

Dr. Hodgins: Well, perhaps my own background leads me to make this point as emphatically as I can, because I possess an engineering degree and my doctorate is in pure science and I have worked in both spheres. I can understand the evidence that I have read and which has been presented to this committee and I can understand the apprehension of the science community of Canada that in the current and proper focus of Canadian production, which will affect the quality of life in this country in the foreseeable future, we may depreciate the total effort in pure science. Fundamentally, I think, I am an engineer and I am convinced that, because of its nature in applying and being concerned with exercises in synthesis rather than analysis, engineering should be a structured activity. I am not sure that our brief is unique in this, but it is one of the very few that do not talk about money. Our brief is more concerned with personnel. I will come back to management in a moment and I will have a word or two to say about that. I am not being as tough on management as Senator Grosart implies. I am suggesting that the education of this management is a keystone. But if you are going to structure the engineering program, you have to have two sets of guidelines.

In this regard I think Senator Grosart asked a very important question. But if you add up all the proposals made to this committee, this country, in paying for them, would go into an abyss of economic disaster from which it would never recover. As we see it, the way to set up jobs that need to be done is what we are alluding to right now. I think, to answer the question that was asked, I should put it this way. We have a recently formed engineering innovative group in the universities mostly operating in a rather diffuse way.

I think we have to make an honest inventory, and I think that I should point out that we are well on the way to doing so.

The Chairman: Do you tend to work closely with the school of business administration or the school of business management in your universities?

Dr. Hodgins: Yes. I have two new programs coming out this year jointly, one at graduate level and one at under-graduate level. What we are trying to do right now is to identify areas of excellence in which deans of engineering will be pretty blunt and say "this is what we could do with distinction." Now this is hard for most of us because most of us are quietly convinced that we can do anything with distinction. However, we are getting a little tougher now and it is interesting to note that the schools that have a better developed program underway are inclined to say "we can do four things." The schools with little experience that are just starting are inclined to say "we can do 17 or 18 different things with distinction." This at least is showing up where the gaps are. This is being done under the auspices of the NRC Joint Committee.

Let us take the gap in transportation, for example; there is very little hardcore nucleation of transportation work in this country. Then there are the gaps in production engineering and this relates directly to the productivity problem. Some of us should be starting on production engineering. My university has a program coming up with the business school to which final consideration will be given next Friday. But, as I say, there are gaps showing up. If a massive attack were to be launched against any one of these things, it should be against the background of this personnel inventory that is being developed. On the other hand, I think it would be quite disastrous for pure science to say that university A ought to say "that we are going to focus the attention of the scientific community on nuclear magnetic resonance." This would be a disastrous thing because science should be as structured as we can keep it, and we should not lump this into an amorphous policy largely to protect the freedom of scientists to continue their pursuit of knowledge unfettered.

Everybody is talking about "mission-orientation" and the scientist would be the loser if that were too amorphous a policy.

Now to expand a little bit on this question about management, I was almost quoting the

Economic Council Report. We make a suggestion that is being tried and will be tried out next year, and its indictment was a pretty tough one. It dealt with what our problem is in order to get innovative activity into Canadian industry. We have to convince two jurisdictions and perhaps three that it is a good thing. We have to convince a Ph.D. when he graduates now from a Canadian engineering school that he can contribute to industry in ways other than research in his own narrow line of endeavour. That is the first thing. Then you have to convince the university that this man should be broad enough in his abilities to assist industry in a broader spectrum than his own narrow thesis. Then you have to convince industry that a man who has come out of a Ph.D. program can in fact interact with his industry profitably to show a profit. Now, none of these three groups is really convinced of this fact, and in order to get the show on the road we are suggesting that post-doctorate fellows—and this would be an interesting and not very expensive experiment—should be encouraged to carry their fellowships not to another graduate school but to industry with federal support. This is the only place where we suggest that money should be spent in this area. This is now under consideration by the National Research Council.

Senator Carter: Would he use the facilities of the university?

Dr. Hodgins: No, he would go into an industry where, perhaps, they had no experience with this type of personnel. This is not unlike the Ford Foundation Residency Fellowship system which has been quite fruitful. He goes into industry and he grapples with a problem set up by industry—a problem that they want to solve. When he is finished, we are urging that both the candidate and the industry write a report evaluating the exercise and these reports would frequently be very different in nature. We hope in this way to convince some of our doctoral candidates that they have a use in industry beyond the narrow spheres they have in their doctorate program. We hope to convince industry that this man has earned a profit and that therefore they should hire three more.

Senator Grosart: What concerns me here is that this is not a normal function. It would seem to me that this should be a normal part of the entrepreneurial process. Normally it seems to be good at this sort of thing—the findings of ways to make a profit.

Dr. Hodgins: We have many industries in this country that have never employed a man with an advanced degree. There is at the moment an over-production in many areas of Ph.D. people and many of the industries which have never employed such a man cannot envisage the usefulness of such a man. We had 432 applicants for post-doctorate fellowships in Canada last year. So, you will see, that there are people available to put into these positions.

Senator Grosart: What I meant was that generally the system is pretty good at looking around and finding ways to make a profit. If this system that you suggest is a good one, why have they missed it?

Dr. Hodgins: The way I put it is the way you have suggested. They have been slow to learn the lessons about industrial research and development which are available to us.

Senator Carter: Do we have any sort of inventory of industries and their lab facilities, their research facilities and capabilities?

Dr. Hodgins: Yes, certainly in the chemical industry. I am not sure that is right across the board though.

The Chairman: Not in a unique document of what Canadian industry is doing, not that I know of.

Mr. Templeton: I do not think there is, except in certain specific things, but in the newer technologies sometimes the veneer is so thin it rests with only one or two people, and this is the key. It seems to me we have been trying to tell the services and supply department they have to get some kind of computer program with the technical capabilities in Canada, so they can get a print out as to where the technical capability is and how big it is. At the moment there is not even a catalogue by which you could classify the people.

The Chairman: I suggested to the Canadian Manufacturers Association last Monday in Toronto that they should make such a survey in Canada, and they seemed to be a little surprised at this suggestion. I do not know what they will do with this, but I do think this is one of the sectors where we know very little—at least, those who are not involved in the day-to-day business with them.

Dr. Hodgins: The Canadian Chemical Manufacturers' Association have done so.

The Chairman: But that is only one sector.

Senator Grosart: There is nothing really comparable to the inventory of the chemical industries?

Dr. Hodgins: No.

Senator Grosart: And it is not complete; it is more on papers than projects.

Senator Carter: How can you bring your pool of manpower together and match them with the industry, unless this information is available?

Dr. Hodgins: This is simply in the discussion stage at the National Research Council. We were thinking of the same sort of mechanism by which we have been operating the PIER fellowships—the post-industrial engineering research fellowships—in which the man from industry is awarded a fellowship to return to university to upgrade. We were thinking of the flip-over of that policy, to put some university men into the industry who already have advanced degrees.

The Chairman: This is done in the National Research Council labs, through the National Research Council in universities. You are asking that it be done in industry?

Dr. Hodgins: Yes, so that industry will be one of the locales of these people.

Senator Carter: Do industries tend to keep their problems secret so that if they are working on a problem they do not want a competitor to find out about it and come up with an answer quicker?

Dr. Hodgins: This is one of the early things we worried about, and we have had replies from a variety of industries who say they can overcome this by a contract the man signs on his entry which restricts him from the purveying of information. It is not any different from a man going into industry, who then quits within two years and moves. This is the same kind of undertaking.

Senator Grosart: To change the subject—and this may not be a fair question, but in view of the important role that deans and associate deans of engineering played in the ING decision—which I am neither criticizing nor supporting at the moment—can you suggest how it came about that after the Science Council and the Science Secretariat had made reports, very extensive reports on this, the views of the deans and associate deans of engineering had to come to the attention of the Government by a newspaper report, or

appear to have so done? You remember it? You would have been in the middle of that.

Dr. Hodgins: Yes, indeed, and unrepentantly so too. This was not the only time it went to the Government, if that is what you are suggesting.

Senator Grosart: No, but one of the two reasons given by the Government for the decision was that there was a difference of opinion in the science community, and the Government statement indicated that the discussion between the associate deans and deans of engineering was overt evidence of that lack of unanimity in the science community.

Dr. Hodgins: The newspaper report to which you allude really contained the substance of our report to the Science Council.

Senator Grosart: As a matter of fact, it was a letter.

Dr. Hodgins: Yes, it was a letter. We wrote a letter on behalf of the deans of engineering, and our basis for concern was not that the project in itself was an unworthy one, but that it had not been examined in comparison with other projects of national significance. Of course, the argument that can easily be brought to bear on that is, "Well, so what other good idea has been produced in Canada?" Of course, the deans of engineering had the retort to that: "So what other project had \$3 million to \$4 million development money put into it?" It was our concern that a project of the magnitude of ING, which could in fact distort the general effort in the country, should at least be considered by comparison with other projects.

The Chairman: You mean "distorted further"?

Dr. Hodgins: Well, yes, I suppose I do. We were convinced that a project of that magnitude in Canada should be examined against other national objectives which had not yet been elucidated.

Senator Grosart: I am not so concerned with the justification for one position or another on this, but I am with the fact that here we had two very thorough-going studies, perhaps as thorough-going scientific studies as we have ever had on a single project in Canada, and that certain deans of engineering had to go to the extreme of writing a letter to the newspapers to have an opportunity to influence national science policy. Surely, this is

not the way we want to have national science policy decisions made? What concerns me is why the deans of engineering who had contrary views were not in the picture.

The Chairman: I suppose they were, but they did not want to take any chances, and they were trying to appeal to public opinion as well.

Senator Grosart: I am wondering, from the point of view of the mechanism of science policy, if this is not quite the same thing as saying, "We will wait and see if anybody writes a letter to the newspapers."

The Chairman: But you were consulted by the Science Council.

Dr. Hodgins: We wrote a letter to the Science Council.

The Chairman: You were not consulted by them?

Dr. Hodgins: I do not know how you would interpret that. We took the initiative, anyway. The Science Council did not come to us and ask us to express an opinion.

Dr. Quittenton: Mr. Chairman, I should like to point out that one of our committee members has connections with the Southam Press, and he is an engineer. Have you anything to say on this matter, Mr. Southam?

Mr. W. W. Southam, Engineering Research & Development Committee, Engineering Institute of Canada: I am not quite familiar with what this discussion is about, but certainly I am not against the press receiving letters from people who want to make sure that the public pays attention to what their views are. I do not think I can really add anything to the matter.

Senator Grosart: Would you care to comment on the statement made the other day by one of our science writers that one of the problems in the development of a national science policy is the lack of good science writers and good science reporting.

Mr. Southam: Certainly, the development of specialists in different areas of reporting on science, medicine, and so on is giving us in the newspaper business some concern. It is a very difficult problem, but we are working on it.

The Chairman: You are perhaps one of the group of newspapers that has attempted to do more than the others.

Senator Grosart: I should perhaps say, because the press is here, that some of us are surprised at the extent and excellence of the reporting of our proceedings.

The Chairman: I should like to ask another question, and that is: How many engineers are there on the Science Council now?

Dr. Hodgins: I cannot answer that offhand. I think the Science Council is roughly half engineers.

Dr. Quittenton: There is a gentleman at the back who can answer that.

Mr. A. H. Wilson (Science adviser, Science Council of Canada): Six.

The Chairman: I am referring to members who are not civil servants.

Mr. Wilson: I cannot tell you the number offhand without looking at the list, but there are six altogether, and three others who have very close ties with engineering.

The Chairman: But were these people involved in the preparation of the report of the Science Council?

Dr. Hodgins: Yes, including a dean of engineering who was on the Science Council.

Mr. Templeton: I think that in defence of the Science Council I should say that we seem to have left the impression that they would not listen to groups. This has not been my understanding or feeling. During the last year I have visited Ottawa many times in order to talk not only to the Science Council but also to various departments, and I think that they do want to listen to us. They give us a very good reception, and they consider these things. The big problem is in the fact that there are so many diverse groups that they are having difficulty in putting them all together.

Senator Grosart: That is exactly my point. I was not criticizing the Science Council, and I come back to something I have said many times already and that is that the big problem, as I see it, is in the fact that the science community itself has not developed some kind of mechanism that will provide a vehicle for the input of the views of the science community into national science policy decisions. The longer I sit here the more convinced I become that it is probably a mistake to keep saying: "The Government should do something. The Government should set up a mechanism. The Government should consult

with us more. The Government should co-ordinate our views." The solution may well be in the science community's saying: "We are going to set up a mechanism to tell you our part of the story."

The Chairman: We were told last night that there were at least 67 different professional organizations interested in science policy research in Canada. So, until there is some kind of unified channel for making representations to the Government this business of consulting on various projects becomes of little importance because you cannot imagine the Science Council or a minister consulting with 67 or more organizations. All having different points of view. These organizations must have an opportunity of threshing out their own differences before making representations to the Government. There are organizations like the CMA, which makes an annual representation to the Government. The CMA is composed of members with widely divergent interests, but they come out with a common ground and a common approach, and they make their annual representation to the Government.

I think the science community, including the engineers, will have to work out some kind of channel by which they can make a representation to the Government in a more orderly way than has been the case up to the present.

Senator Grosart: It is an amazing thing, Mr. Chairman, to look around Ottawa and see all the buildings that have been erected to house the voices of the various segments of the community. The Canadian Legion has a building, and so have the principal labour organizations. They are here to tell the Government what labour wants and what the veterans want.

Dr. Quittenton: You are talking about a scientific lobby?

The Chairman: Yes, but in the very good sense of that word. It is part of our democracy. After all, citizens and their organizations have a right to make representations in their own interests to the guardians of the public interest.

Senator Grosart: You can call it a lobby if you like—and as I said last night, "lobby" tends to be regarded as a dirty word—but I am sure that every minister considers that it is an obligation of all people to tell the Government what they want, and to indicate to the Government the effect of future decisions

on their interests. We are back to the basic fact that the essence of democracy is the conflict of views, and the essence of politics is the compromise of those views.

The Chairman: I do not think we are able to progress any further in that direction today, so we shall leave it for further reflection. As I said last night, we had the impression that communication between the scientific community and the Government in the United States works better than apparently it works here, so perhaps we can learn something for once from the United States. I would hope that your various organizations will look into this more than they have apparently been doing up to the present.

Senator Carter: I should like to ask one more question. Dr. Quittenton mentioned that one of our national objectives should be in connection with work at the interface of the computer between the machine and the man. I am wondering whether, in this pool of manpower that we have, we have people sufficiently trained to develop this aspect of computer science.

Dr. Hodgins: Yes, sir, that is one area that is well populated by people with expertise. Some people are publishing text books, and there is quite a long history of interface industries. There has been a lot of industrial

co-operation in this particular area of the development of software systems for describing complex industrial operations. There is a lot of personnel in this area.

Senator Carter: I am rather surprised because, although it is not a new science, it is certainly one that has taken rapid strides in recent years, and one in which I thought we would be behind.

Dr. Hodgins: Canada is well equipped to enter the software industry.

The Chairman: Ladies and gentlemen, I think we must now bring this meeting to a close. I certainly have other questions to ask. I think that this morning we have only just started a new process of consultation. As a matter of fact, we are continuing it because we have heard from many other associations like your own in the last few days. It is the intention of this committee further to consult with you so that at least there will be closer liaison between the scientific community and one chamber of Parliament.

Dr. Quittenton: Good. Formidable.

General Carrière: Thank you very much. Merci beaucoup.

The committee adjourned.

APPENDIX 115

A BRIEF TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA

by

The National Committee of Deans of Engineering
and Applied Science

January, 1969

BRIEF TO

THE SPECIAL COMMITTEE ON SCIENCE POLICY OF THE SENATE OF CANADA

Submitted by

The National Committee of Deans of Engineering and Applied Science

Introduction

Perhaps the most significant fact about engineering education in Canada today, is the dramatic increase in postgraduate studies over the past decade: 600 in 1958, 1,450 in 1963, and 3,646 in 1968. Since there has been a corresponding increase in the number of engineering research directors on the various faculties, this means that there is now in existence in the universities a task force of engineering innovators which simply did not exist a decade ago. This fact will form a recurrent theme in this brief, for it has great relevance to the main aim of this Special Committee -- the pressing necessity of developing a cogent policy for science and technology in Canada. In addition to identifying projects of importance and assigning priorities to them, an equally important (and considerably more complicated) problem, is the development of a rapid and incisive mechanism of making decisions on how best to get the necessary work done.

In many respects, Canada is today at a time of decision not unlike that of the United States in 1862. At that time, Representative Morrill of Vermont sponsored the Land-Grant Act; this piece of legislation proved to be one of the fundamental stimuli for the ascendancy of the United States to the status of a world power in the mid-twentieth century. In 1862 it was fairly simple to identify critical national problems in the U.S.A. -- there were enormous tracts of arable land to farm, long distances to travel, and a relatively small population. It was not hard to see that an effort had to be made to develop efficient farming procedures, imaginative new farm machinery, and power conversion devices for doing farm work and for ground transportation. And thus the land-grant colleges came into being, for the purpose of improving and devising agricultural methods

and for the development of the mechanical arts. In the ensuing years, a nuclei were created in 48 states where faculties skilled in these matters assembled, and from these colleges developed a matrix of expertise across the whole nation, which has had a profound effect on the technology of the whole world.

In Canada today, as the result of dramatic improvements in agricultural, mining, and forest technology, the number of people involved in our primary industries is likely to diminish, although their skills will steadily have to increase. There will be a corresponding swing towards secondary industry for two reasons -- the population shift to urban areas, and the extra profits deriving from more elaborate processing of our natural resources. We aspire to a mode of life which is luxurious by international standards, and we shall therefore have to devise the means of competing successfully in the global marketplace. We shall have to make brave and perceptive decisions as to the most effective deployment of our resources -- the most important of which at this moment seems to be our scientific and technological manpower. And the name of the game is productivity.

It has really become quite clear -- as emphasized by several of the witnesses who have earlier addressed this Committee -- that a significant swing of effort into applied, or "mission-orientated" work must be accomplished in a relatively short time, if Canada's economy is to be stabilized by a large increase in activity in the secondary industries; we are already a serious contender for the title of the world's most tax-laden citizenry. And this is why the task-force of engineering researchers in Canadian universities could play a crucial role in the next decade. It also underlines the importance of Committees such as this, for an aggressive attack must be made on the development of national policy, the rapid taking of decisions, and the most effective execution of the decisions, once taken. Technology is swift and competitive -- if we are too ponderous about getting on with the job, the rapidly changing technological environment will render the decisions invalid all too quickly.

In October, witnesses from the National Research Council presented an interesting and detailed brief on the fine record of accomplishment of that body, and described the status of their forward planning, as the most important single research organization in this country. Quite properly, their statistics presented data for science and engineering combined, for the National Research Council has heavy commitments across the full range of endeavour from fundamental research to short-range applications. It is probably appropriate to emphasize in this brief,

that since engineering is an applied science, not only are the motivations different for engineering than for science, but the very nature of mission identification and orientation make possible a different kind of policy to optimize the impact of its research programs. Pure science is absolutely essential to the scientific well-being of any nation, and Canada's achievements in this area have deserved the fine international reputation which has been built up. It is in the area of engineering science, applications research, development, and design, that this country has lagged, and the reasons have been documented elsewhere.^{1,2,3,4.} One of the results of this lag is the fact that the development of a significant engineering research community is so very recent.

Some Characteristics of Engineering Research in the Universities

Innovative work in engineering falls into three fairly distinct categories:

(a) Basic research (engineering science):

This work is applied science carried out to provide a fundamental background in the whole spectrum of engineering disciplines. Its aims are almost identical with those of pure science -- to extend the boundaries of existing knowledge. Examples of this category would be fluid mechanics, aerospace physics, solid state development, and quantum optics. It is almost certainly best fostered by the same procedures as are employed for pure science -- grants based on the competence and productivity of the individual workers, in the judgment of his peers.

(b) Applied research:

Ideally, most engineering research will fall into this category -- work aimed at developing new techniques, processes, or systems. This is usually long-term research, with well defined technological, economic, and sociological objectives. It should have industrial involvement, at least at its later stages, and should in the main, fit into some clear system of national objectives. In jargonese, it should be "mission-oriented". Examples are: computer simulation of industrial processes, special alloy development, chemical reactor design.

(c) Development and Contract Work:

This type of innovative activity is characterized by its intense involvement

with industry, and by the short time-scale on which it is performed. Graduate student involvement is not very common because of the frequent necessity of protecting the proprietary rights of the sponsor, and of the specific deadlines which must be met. It is important to the engineering school that some of this work is maintained, to keep faculty alert to commercial realities, and to get done certain necessary technological tasks of such mission-oriented agencies as the Department of Industry. Examples are: control system design for a specific chemical process, cooling system design for a steel rolling mill, the development of software packages for specific industrial processes. This type of work must be fully funded by the contractor.

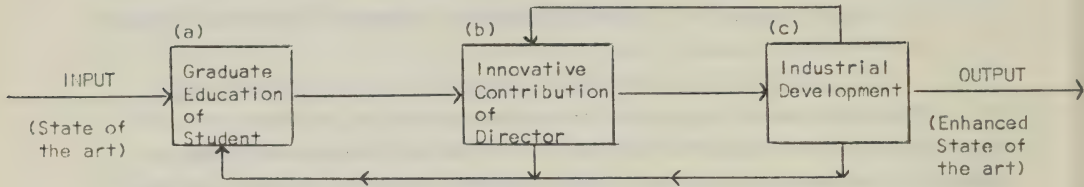
There are several aspects of the current status of university research in engineering which should be recorded at this point. Canada has 25 degree-granting engineering schools, which means that the effort is disperse and un-coordinated. There is no question that some focussing is required -- some "research on research", so that benefit functions can be derived, kept up-to-date, and publicly discussed. It is necessary to deploy our engineering research forces so that the right projects are undertaken, in the right place by the right group of people, in order that maximum public good may result. This will involve the charting of a "delicate course between the Scylla of disconnected initiatives and the Charybdis of inflexible central planning".⁵

The increase in graduate enrolment over the last decade, with its attendant increase in research activity has been financed largely by a single granting agency -- the National Research Council, rather than by a multiplicity of agencies with a diversity of aims and objectives. The imbalance is a Canadian phenomenon, largely the result of the flaccid efforts of the emerging secondary industry in the field of research and development where Canadian entrepreneurship is still at a low level of vitality. Most industrial engineering projects have been pretty short-range in character, so that Canadian managements have yet to develop an appreciation of the nature and function of long range, engineering-based innovative development programs. As a result, the direct support of university engineering research and design programs by industry has been of little consequence. The necessary elements of university engineering research may be represented diagrammatically, after the fashion of the systems engineers. The aims are, in

order of priority:

- (a) To educate the graduate student
- (b) To maintain and extend the innovative ability of the professor
- (c) To break new ground in the technology of our country.

The important thing to note of these three aims is that they comprise an integrated system, composed of three intensely interacting variables. The feeble functioning of any of the three elements will produce a distortion in the performance of the system, which in the extreme case causes instability. The resultant interactions look something like this:



Thus, the education of the graduate student (a) is highly dependent on feedback from (b) and (c). Unless the research director is alert to modern techniques and threshold developments, the student's education will suffer. And the professor will be less than adequate if his industrial rapport is feeble.

The current imbalance in support and in interest has had a very real effect on the nature of engineering research in Canada. In the absence of vigorous industry-university dialogue, an unduly large proportion of engineering research projects in the universities has been pretty abstruse, intensely fundamental, with little or no economic connotation. Moreover, with such a languid industrial interest in engineering Ph.D. graduates, the brain drain has developed, and the only substantial appetite in Canada for these men has been in the engineering schools themselves. The result is that the university engineering schools are accumulating faculties with little industrial experience or attitude, and the dialogue between industry and engineering school remains sporadic and inarticulate. A corollary to this state of affairs, is that the engineering-society dialogue is not fluent either, a situation which must be corrected quickly, if we are to maintain and enhance the quality of Canadian life.

The Science Council has already expressed itself on the relatively small portion of research expenditure in Canada devoted to development work, which is largely an industrial obligation:⁶

PERCENTAGE OF TOTAL RESEARCH EXPENDITURE

| | <u>Canada</u> | <u>U.S.A.</u> |
|----------------------|---------------|---------------|
| Basic Research | 22 | 12 |
| Applied Research | 41 | 22 |
| Development Research | 37 | 66 |

This discrepancy in the development expenditures constitutes a comment upon Canadian industrial entrepreneurship, and is reflected in our lower productivity. Based upon these data, and other factors, the Science Council made several relevant recommendations:

1. "It is recommended that in future every new research or development be critically examined at its outset to identify the appropriate organization to carry through the project to its final conclusion. For extensive programs that encompass many individual projects, the distribution of these projects among the sectors of the economy must be considered. Such a procedure may well lead to the universities and industry performing a larger share of the research in Canada than has occurred in the past."
2. The Federal government should:
 - (a) "... further encourage industrial involvement by contracting out federal programs where participation is likely to increase the technological or innovative capacities of the companies concerned. The underlying objectives should be to upgrade the overall capabilities of those involved, and ultimately to develop self-supporting research organizations in Canadian industry."
 - (b) "... through its mission-oriented departments actively seek to promote industrial and university work in support of each mission as well as responding to initiatives from the private sector."

The foregoing are positive recommendations, which would be enthusiastically assisted in their implementation by the university engineering schools, which could supply graduates to a burgeoning industrial demand, and provide research personnel in the cooperative attack on problem solution. There is little question that such a quickening of the entrepreneurial pulse must occur, if Canadian productivity is to match the abrasive atmosphere of the world markets; the engineering schools would jump at the opportunity to cooperate.

Canadian management has been astonishingly slow to read the lessons about industrial research and development which abound all around us -- In the United States, Sweden, Italy, Germany, and particularly in Japan. The low level of interest in employing engineering Ph.D.'s threatens to perpetuate this entrepreneurial lethargy, for developments which will affect the economy fifteen years from now, should be underway to-day. To point out the fact that Canadian research and development enterprise does pay off handsomely, three examples come to mind:

- (a) The annual royalty to the Province of Alberta when the Great Canadian Oil Sands plant reaches full production will be about \$5,000,000. The total expenditure on research on this project will be recovered in profit in the first six months' operation.
- (b) The story of the spectacular development of Radio Engineering Products of Canada is currently in the news. It is disturbing, however, to realize that the vicious estate taxes in Canada have prompted the sale to a foreign company -- a common story about family-owned Canadian corporations, such as Donald Wire Rope, and National Aniline and Extract. The net result of such sales is frequently to reduce the Canadian content of research and development, and almost invariably acts as a curb upon research initiative as the family owners approach retirement age.
- (c) The annual interest on the potential savings anticipated on the Brazeau power and water storage scheme in Alberta, far exceeds the total expenditure in the research which made these savings possible.

Volumes could be filled with similar case histories, so there is no dearth of persuasive evidence. Somehow, it has failed to raise much of a gleam in the Canadian industrial eye. The cultivation of the right kind of Canadian management is in a very real sense, an important keystone of national science policy.

There is therefore a major gap in Canada between the financial community and the technological community. A recent study by the Toronto Stock Exchange⁷ shows that there are two Canadian investment dollars seeking investment for every dollar of equity available. This means, of course, that Canadian entrepreneurship is lagging far behind the ability of our country to assemble capital for industrial investment, and the extra dollar goes into Xerox, I.B.M., Texas Instrument, Itek, and scores of other intensely technological industries in the United States.

RECOMMENDATIONS

1. The existence of a significant cadre of engineering research workers in Canadian universities makes it now imperative that engineering be recognized as a distinct entity, and not as a branch of the sciences, in parallel with physics, chemistry and biology. Engineering motivation is quite different; it deals with synthesis of information and techniques at least as much as with phenomenological analysis; and it must involve itself with economics, sociology and ecology, if it is to make its proper contribution. That this state of mind has not really been attained is clearly revealed in the presentation of data by the National Research Council to this Committee -- all of the statistics dealt with "science and engineering" as if this combination were homogeneous and amenable to the same policy considerations. In 1966, the National Committee of Deans of Engineering and Applied Science advocated the formation of an Engineering Research Council as an adjunct to the National Research Council, in order that the essential differences in science policy and engineering policy could be developed. Although this recommendation was not implemented, at least a move in that direction has partly been made, in the appointment of a Vice-President (Scientific) of the National Research Council (Mr. R. D. Hiscocks), whose duties include the following:

- (a) "... In collaboration with Dr. L. G. Cook (Délégué-Général) will develop and promote policies and will have administrative responsibility for all programs for industrial research assistance and promotion. This will include the development of closer contacts with industry and other applied research laboratories."
- (b) "All programs in this area will be coordinated with the Council's program of grants to the universities and with work in the N.R.C. laboratories and other government agencies."

These terms of reference have in them the elements for the development of a specific national engineering policy. This constitutes an opportunity which should be aggressively exploited.

2. The position of the Science Council as a senior, detached (from an operating agency) advisory group seems to be quite clear. It has now identified the priorities of several pressing Canadian problems.⁶ This is a vital first

step -- priority must be given at all times to fields that are likely in some way to contribute to the solution of a pressing human need, and will always refer to applied research or development -- the slow, costly elements of engineering research. But the next, and probably more complicated phase of decision is now illumined -- the identification of the group of researchers around whom will assemble the task force for attacking these priority problems. As one responsible group, the deans of engineering are now proceeding with a (hopefully) dispassionate assessment of the relative strengths and weaknesses of their faculties, as a necessary element of such decision. It is quite urgent that groups of experts be assembled to weigh the relevant evidence and identify the centre of activity for attacking these priority problems. The decisions should be based upon people, rather than facilities, with the result that an "institute" might embody efforts from several universities or research organizations. The baleful effect of cllustering most of the researchers under one roof has often been demonstrated -- it usually results in a curtailment of innovative ideas.

3. As a corollary to the above recommendation, it is important that relatively early action be taken to provide central coordination for the research undertaken on the priority problems. Taking, as an example, the Canadian transportation problem, there are already at least six agencies at various levels of government declaring their involvement, irrespective of their qualifications for the job. Herein lie the seeds of mediocrity -- too many uncoordinated and relatively unsophisticated research designs, too much overlapping, too many gaps, not enough horizon-to-horizon vision. Transportation has an enormous impact on the Canadian way of life; it demands a massive systems analysis, and research coordinated so that the flowlines are most efficiently established for municipal, provincial, and federal needs. This can only be done by optimizing the efforts of the meagre supply of personnel available for this study; anything less than a clearly identified institute will be ineffectual in exploiting the enormous opportunities in such a national priority problem.

4. In order to feed more diversity of opinion into the applied research programs of Canada, there should be a broader base of sponsorship of university research. This can be assisted if those mission-oriented government departments

(e.g., Agriculture, Industry, Energy, Mines, and Resources) expand their extramural research programs.

5. Some way must be found to increase the incentives for stimulating Canadian industrial research and development. One method might be to subsidize in some way, the employment of Ph.D. engineers for a number of years. This would have the added effect of upgrading the educational level of future management.

6. The federal policy on estate taxes encourages the sale of family-owned Canadian industries to foreign purchasers. This of course has a direct stultifying effect upon Indigenous research and development and should be considered as an element of Canadian science policy.

7. The National Committee of Deans of Engineering and Applied Science is eager to participate in the best attacks on Canadian technological problems. This group has already expressed its corporate opinion on several aspects of national science policy, and would welcome a positive role in the development of Canadian technology.

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APPENDIX 116

BRIEF SUBMITTED TO
THE SENATE SPECIAL COMMITTEE ON
SCIENCE POLICY
BY
THE ASSOCIATION OF CONSULTING ENGINEERS OF CANADA

Special Committee

BRIEF SUBMITTED TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
BY
THE ASSOCIATION OF CONSULTING ENGINEERS
OF CANADA
176 ST. GEORGE ST., TORONTO 5, ONTARIO.

1. In this period of rapidly changing technology there is a very great need for forward thinking and for Canada to assess the challenge of the future. Not only must this appraisal be of a multi-discipline nature but it must also be multi-organizational so that goals and objectives can be meaningful to the country. The people of Canada must become aware of and approve these objectives. We agree with the Science Council when it says "The objective selected for each major program must be of real importance to Canada, and perhaps even peculiar to Canada.".
2. This Association -
 - (a) The Association of Consulting Engineers of Canada has 299 member firms employing 17,800 technical personnel. These employees are primarily engineers and their assistants, but also include other disciplines as well. Thus the Association represents a fairly comprehensive group engaged in specific endeavors. Its members are of a "floating nature", available to all levels of government and to industry, ready for employment during the period that they are needed. The member firms of the Association vary from very small firms of one or two men specializing in a specific type of engineering, to large inter-disciplinary firms employing one thousand people.
 - (b) To be a member of the Association, firms must have established not only their technical and professional capabilities, but also that they are able to operate their practice successfully.

3. Canada Needs -

(a) Because of the complexity and inter-relationship of many of our country's problems, there is a need for an inter-disciplinary approach to our methods of tackling them. This is quite evident in major problems such as transportation, urban development and water resources, and is also needed in many other less obvious areas.

(b) In addition to the inter-disciplinary approach there needs to be an inter-organizational approach. This needs to link together all levels of government, industry, university and technical advisors. At the present time there is some tendency for each group to try to live alone in its own environment. The sooner this tendency is broken down, so that each recognizes the role and the necessity of the other, the more scientifically competent we will become.

(c) There seems to be a somewhat defeatist attitude in Canada that we do not have the technical skills necessary in many aspects of scientific endeavor. This is very discouraging to people who are competent but who do not have a chance to prove their competence.

(d) We need to develop an attitude that it is our job to search out the Canadian skills that are available and to use them to their utmost, resorting only to the importation of skills when we are sure that they are not available at home. Many projects in which we ask for foreign help could well be managed by Canadians with perhaps some technical help in a few areas. If we do not take the initiative we will never develop such skills, and those people who have the ability to contribute will leave for countries where their capabilities will be recognized.

(e) We believe that research and development capabilities are needed in Canada on a "floating" basis. Many of our large industries are subsidiaries of foreign firms who depend on their head offices for research and development. Smaller firms who cannot afford in-house research and development capabilities thus have difficulty in competing. They could effectively utilize the services of a pool of research and development specialists who would be made available to them on an as-required basis. At the moment we cannot suggest

how this should be accomplished, but certainly if government, industry and consultants decided it was a worthwhile objective for Canada it could be made to work.

4. Canadian Exports Follow Consulting Engineers Work Abroad -

We are convinced that the export of Canadian products follows when Canadian consulting engineers are employed on foreign projects. They specify the materials that they know, providing a valuable way to introduce Canadian products into world markets. The Department of Industry, Trade and Commerce recognizes this advantage and very effectively promotes Canadian consulting engineers in other countries. We develop this topic further in Appendix "A", which is a brief that asks the government to assess the value to the Canadian economy of the government "making" rather than "buying" engineering services.

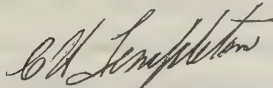
5. What We Can Do -

(a) Consulting engineering firms have established in their sixty years of work in Canada that they can organize and manage technical organizations. The skills are from many scientific disciplines. They may be involved in any of the principal phases, such as project studies, planning, designing and construction management. This management capability, in addition to the technical capability, should not be overlooked because when the inter-disciplinary and inter-organizational approaches mentioned above are used there needs to be a very strong management team to produce meaningful results in a reasonable time. The consulting engineering firms regularly employ and work with other disciplines and could, we feel, fill a very necessary role in this area.

(b) We now have skills in a great many of the industrial and governmental endeavors in Canada, although there are some notable exceptions such as the petro-chemical industry. Such exceptions are unfortunate and deprive Canada of the technical resources to innovate as broadly as we would wish. We agree with the Science Council's comments that to have such skills is a prime requirement of Canada's scientific community.

(c) In this brief we have suggested some of the many problems facing the Canadian scientific community. We do not have the answer to all of these problems, but we would welcome the opportunity to participate not only in setting goals but also in achieving them. There is in the consulting engineering profession a large and capable pool of skills. We would like to use these skills to a greater degree in planning to meet the major problems facing Canada.

Respectfully submitted,
by
THE ASSOCIATION OF CONSULTING ENGINEERS
OF CANADA



C. H. Templeton, P. Eng.,
President.

WHAT IS THE IMPACT ON THE CANADIAN ECONOMY OF
GOVERNMENT "MAKING" RATHER THAN "BUYING"
ENGINEERING SERVICES.

1. The Science Council has pointed out that if our country is to achieve its objectives for economic growth it must seek ways to expand its international trade.
2. Our Association, having many of its members carrying out overseas assignments, realizes the importance of increasing our exports and wishes to point out the tremendous leverage which the export of engineering services has in increasing our international trade in manufactured goods.
3. Perhaps the best way of indicating the extent of this leverage is by example. One of our member firms in joint venture with a U.S. firm was successful in obtaining from the Pan American Health Organization, the design and supervision of improvements to the water system in Port-au-Prince, Haiti. This assignment was obtained without the benefit of any Canadian financing. When the design was completed tenders for the construction contract were advertised on the international market, and largely because a Canadian engineering firm was involved, two Canadian contractors decided to prepare bids. Both bids were lower than others received and eventually the contract was awarded to one of the Canadian contractors. As a result the piping, pumping equipment etc. are being purchased from Canadian manufacturers. The total cost of the project is \$2.6 million, of which it is estimated that \$1.8 million or 70% is being spent for Canadian goods and services. The total fee for engineering services is about \$350,000.

4. This example indicates a leverage of about 5 to 1 in terms of the total sale of Canadian goods and services resulting from the initial sale of engineering services.
5. It is not known whether the leverage indicated by this example can be considered representative and it is acknowledged that a range of projects should be studied to better assess this factor. The example does illustrate, however, that the sale of engineering services abroad has a significant multiplier effect on our volume of exports and therefore should be encouraged by government policy.
6. For Canadian engineering firms to obtain overseas assignments against international competition is not easy and requires considerable effort over extended periods of time. To be able to support this effort financially the firms must have a strong domestic business. Secondly, to be successful in selling their services to overseas clients, consulting engineers must be able to show a good background of experience on similar work at home.
7. However, current Federal government policy seems to allow for many projects in Canada to be carried out by government employees rather than by private enterprise. The following examples are included to illustrate the point:
 - (a) Saskatchewan-Nelson Water Resources Study

This study is being carried out mainly by P.F.R.A. at an estimated cost of \$5,000,000.
 - (b) Okanagan Basin Water Resources Study

It is understood that this study is to be carried out by staff of the Department of Energy, Mines and Resources at a cost of \$2,000,000.

8. Our Association feels that the Canadian economy would benefit more in the long run if studies such as these were contracted at least in part to private enterprise. To properly assess the size and significance of these benefits would require study by a competent, independent and objective party and we feel that the task is one which is worthy of attention by the Economic Council. Certainly it represents a policy decision on the part of the Federal Government which could have a major impact over a considerable number of years in the future. As is pointed out in your Council's Fifth Annual Review, as we move into a more advanced stage of economic development, with increased emphasis on the value of our human resources, the lead time required for policy to operate effectively may well increase and the need is for appropriate action now.

9. We are aware that the Glassco Commission studied the "Make or Buy" problem and that the Commission's three recommendations (Report No. 10, Chapter 1) have been adopted (Hansard, Page 14543, April 5th, 1967). The three recommendations are as follows:

- (a) The Treasury Board and senior departmental management review all requests for additional staff and facilities to be devoted to the conduct of secondary activities to determine whether the government's new or increased need could not, alternatively, be satisfied by the use of private resources and facilities;
- (b) Accurate and comprehensive cost analyses be prepared to support all requests of such nature;
- (c) Periodic cost investigations be carried out in respect of all existing programmes of

secondary activity, and departments and agencies be required to show cause why these should be continued whenever non-government sources can supply the goods or services at equal or lesser cost.

10. However, the Commission did not look at the effect on international trade and also we are not convinced that the adoption of the three recommendations has been effective in controlling the amount of government staff and facilities which is devoted to secondary activities. We think that a report by an independent body such as your Special Committee assessing the benefits to our economy would be more successful.
11. In summary then, we are requesting that an independent body carry out a study of the impact on the Canadian economy over the long run of government making rather than buying engineering services. Our Association would be pleased to assist with such a study in any way we can.

APPENDIX 117

Association of Professional Engineers
of the
Province of Manitoba



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BRIEF TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
FROM
THE ASSOCIATION OF PROFESSIONAL ENGINEERS
OF THE PROVINCE OF MANITOBA

BRIEF TO
THE SPECIAL COMMITTEE ON SCIENCE POLICY
OF THE SENATE OF CANADA
FROM
THE ASSOCIATION OF PROFESSIONAL ENGINEERS
OF MANITOBA

A. INTRODUCTION

The Association of Professional Engineers of Manitoba operates by authority of the Province of Manitoba under the "Engineering Profession Act". It has about 1300 licensed members residing in the Province of Manitoba.

The Association recognizes the changing role of technology in our society and supports activities which will assist in keeping its members abreast of advances in their specific spheres of activity. Most of all, it protects and serves the public, for which purpose it has the responsibility for licensing Professional Engineers in Manitoba.

The Association supports the participation by its members in the planning and coordination required to define and evaluate difficult areas in science matters relative to society and in the devising of plans for evolving solutions, as well as supporting the cooperation of its members in the subsequent carrying out of approved plans. (These matters must be kept in perspective with our size and resources as an organization).

B. SUMMARY OF RECOMMENDATIONS

1. The Association of Professional Engineers of Manitoba subscribes to the general theme of Report #4 of the Science Council.
2. A way must be found for as broad a participation as possible in the development and achievement of approved programs.
3. Regional development must be considered.
4. Self-generating regional technical communities must be developed.

C. DISCUSSION

1. The Association subscribes to the general theme of Report #4 of the Science Council of Canada. This is an excellent base for studying how science programs should be defined and rated for the benefit of society. We believe that these principles are for the good of Canada and should be explored fully by all levels of government and industry and implemented to the greatest degree.
2. Our Association believes that if these goals are to be achieved on a national basis, they must be broken down into as many components as are required for the whole of Canada to participate in their achievement.

For example, we subscribe completely to the principle that industry must take a far greater role in research and development than it has in the past. But if all the technical skills available for research and development are concentrated in the larger centers, which could well happen, the long term goal of Canada would not be achieved if other centers remained under developed.

3. We believe that the national goals recommended by the Science Council need also to be sub-divided into regional goals, so that technological skills will be developed for goals which are pertinent to specific regions. When we say we would like "regional" goals and objectives to be set, we are not suggesting that regions be subsidized unnecessarily; but only that a sincere effort be made by government, universities and industry to create regional technical communities having sufficient capabilities to be self-generating. Neither are we suggesting that all regions should strive for technical competence in all fields, for to do so would result in capabilities that are too thinly spread out. Rather, each region should strive for competence only in those fields that are meaningful to that region.
4. We are convinced that the key to a strong national technical capability is the development of self-generating regional technical communities. By this we mean that the industries in each community will promote the development of specific skills for their own use. The availability of these skills in turn will generate other industries using similar skills, thus forming a common pool of specifically-skilled people in a particular region.

We are now taking steps to have some forums on this subject, which will discuss Manitoba's goals. Thus we hope that when your investigations progress further we will have more meaningful ideas of what portions of the national goals should be achieved in the Manitoba region.

April, 1969

Association of Professional
Engineers of Manitoba

APPENDIX 118

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

THE ENGINEERING INSTITUTE OF CANADA

The Engineering Institute of Canada which has a total membership of approximately 20,000, is the national organization of Canadian engineers, of all disciplines who wish to exchange technical knowledge, support its publication, associate with one another for their mutual benefit and enjoyment, and constitute a representative voice of the profession in technical matters affecting all Canadian engineers nationally and internationally.

Special Committee

"Upon the whole surface of the globe, there is no more spacious and splendid domain than Canada open to the activity and genius of free men"

- Sir Winston Churchill -

ACKNOWLEDGEMENT

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March 28, 1969

R. C. QUITTENTON
Chairman
Engineering Research Committee

Special CommitteeENGINEERING RESEARCH COMMITTEE

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ADDENDUM --

Compendium of Canadian Views on
National Objectives

NATIONAL OBJECTIVES* FOR CANADIAN

SCIENCE AND TECHNOLOGY

The National Objectives presented herein are based on the precepts which arose from the science policies suggested in the first E.I.C. document, "A Canadian Policy for Research and Development",⁽¹⁾ which was presented on March 3rd, 1967, to the Honourable C. M. Drury, Chairman of the Privy Council Committee on Scientific and Industrial Research. These may be stated as follows:-

PRECEPTS

1. Canada's overall situation is such that a set of national technical objectives is needed, established on a priority basis.
2. To strengthen our economic output it is vital that such national technical objectives should be of real socio-economic benefit to Canada when accomplished.
3. To strengthen our industries, it is equally necessary that the research and development work required to achieve each national objective should be carried out essentially by Canadian industry through mission-oriented programs under governmental financing.

THE PRESENT SITUATION

1. In 1910 an American produced \$62. worth of goods and services more than a Canadian. By 1968 he produced \$1,400. more than a Canadian.

* Footnote: The term "national objectives" is used herein to maintain continuity with the first E.I.C. document. A more meaningful terminology, however, would be "national programs".

2. If this productivity gap continues to widen at current rates it will reach \$3,000 before the end of the century. It is this productivity that governs the standard of living.
3. There will be one-half million Canadians of the working force unemployed within 10 years, based on the experience of the last 18 years.
4. Because of proximity and instant communication with the U.S.A., such differences in standard of living and employment place unique stresses on the social fabric and unity of Canada. This is becoming more apparent every day.
5. The U.S.A. will develop solutions for pressing social problems like pollution, urban blight and the like before Canada, because their need for such solutions is felt to be greater than ours.
6. A survey of Canadian industrial and engineering views on appropriate National Objectives for Canada gave top support for Transportation in its many facets at about one and one-half times the citations of the next closest item, which was for Improved Incentives for the innovative process in Canada.
7. The National Objectives cited in this survey plus those cited by the Science Council, can be divided into two separate groups, one predominantly economic in nature and the other predominantly social in nature.
8. The service sector is now the largest employer in Canada, with 60% of the total employment in this field.
9. The computer offers unique opportunities for new job development and export sales in the service sector.
10. Very many important innovations are being generated by the small or private inventor-entrepreneur. The greater part of the major discoveries now in commercial use are estimated to

come from this source.

11. For optimum results the innovative process requires a very close and effective relationship between venture capital sources, the inventor-entrepreneur and technologically oriented academic centers.
12. The National Research Council and the Defence Research Board have been more successful in the commercialization of their ideas in transportation and electronic instrumentation than in any other areas.
13. The major cost of the innovative process falls not in the initial concept stage but in the implementation stage.
14. The three year tax abatement on profits from geological discoveries is a proven tool for generating new industries, but new manufacturing discoveries can be rendered obsolescent faster than a geological discovery becomes depleted.
15. One organization in Canada with the resources, staff and expertise to play a leading role in a program of National Objectives is the National Research Council.
16. Some overall approach is urgently required to inhibit the serious and growing fragmentation of the Canadian research effort, incorporating the delineation of specific responsibilities.

RECOMMENDATIONS

Based on these findings and the other evidence given in the body of this Brief, the following recommendations are offered to our national policy makers.

1. Preference be given at this time to National Objectives of a predominantly economic or job-generating nature, as these result in eventual improvements of a social nature.
2. The knowhow and legislation proven elsewhere to meet predominantly social objectives, such as, pollution control and urban renewal be adapted to Canadian needs via appropriate legislation as promptly as feasible.
3. Two major National Objectives for Canadian Science and Technology be implemented, one in Transportation, of leading priority, and one in Computer Technology. Both of these have already been listed by the Science Council as National Objectives.
4. Programs in the Transportation Project be set for people, products, power and services, to include:
 - a) Special purpose aircraft (short and vertical take-off and landing vehicles).
 - b) Service industry applications (expanded containerization, etc.).
 - c) Resource industry applications (solids pipelining, etc.).
 - d) Electric power transmission (superconductivity, etc.).
 - e) Construction industry applications (akin to the Service industry).
 - f) The ice problem (hovercraft, submarine barging, etc.).
 - g) Northern development (permafrost treatment, muskeg canaling, etc.).

5. Programs in the Computer Technology Project be set with emphasis on the man-machine interface and software side; to include:
 - a) Education applications
 - b) Service industry applications
 - c) Communication
 - d) Health service applications
 - e) Resource industry applications
 - f) Construction industry applications
6. Canada occupy immediately by space satellites, those space corridors and transmission channels needed to provide an adequate national communication system from space, as urgently recommended also by the Science Council.
7. Legislation be enacted to promote the formation of a Canadian Geoscience Data Institute, owned and operated by industry, to collect drill cores, assays, field data, and air photos etc. of all geological work carried out in Canada, within 10 years of completion, in a compulsory but cooperative manner acceptable to industry, and that a detailed national geological grid then be developed, using the power of the computer, as proposed by the Geological Survey of Canada.
8. Promising geological areas uncovered by the Canadian Geoscience Data Institute be auctioned off by governments for all geological exploration, as is now done for petroleum exploration.
9. An appropriate body be invited to carry out a feasibility study on the control of Canadian weather via the oceanography of Arctic waters.
10. A Small Inventors Act be enacted to find and support the small or private inventor-entrepreneur, on a guaranteed loan basis, to a maximum of \$150,000. per application, with loan decisions to be made by financial institutions.

11. A three year tax abatement be allowed on profits from new manufacturing discoveries invented and worked in Canada, analogous to that allowed for Canadian geological discoveries, to supplement but not to supplant existing incentive programs for the innovative process.
12. A ten year budget be struck by Government for the implementation of the National Objectives and The Small Inventors Act at an initial level of:

\$20,000,000 for the Transportation Project

\$10,000,000 for the Computer Technology Project

\$ 4,500,000 for the Small Inventors Act

increasing by year 10 to:

\$93,600,000 for the Transportation Project

\$46,800,000 for the Computer Technology Project

\$ 6,000,000 for the Small Inventors Act

for a gross investment by Government, at the end of year 10, of \$695,000,000.

13. The National Objective Projects be administered through National Objective Committees, of which at least one-half the members would be from industry.
14. The work required to accomplish the National Objectives be carried out by industry on a contract basis, via competitive bidding, under governmental financing, with industry having the right to subcontract part or all of the work to Industrial or Provincial Research Institutes, consultants, academic groups or other industrial organizations.

APPENDIX

1. Review of Previous Document, "A Canadian Policy for Research and Development".

Since publication in March, 1967, new data and events have become available to permit an assessment of the findings and arguments of this prior E.I.C. report. The main thrust of the work was that the Canadian research effort was unbalanced, being too light on development; that too much of the gross national effort was being done in governmental laboratories; that Canadian industry was not contributing sufficiently to the national research effort; that the total national effort was too low; and that therefore our economy was in danger of gradually being undermined by technical obsolescence. Some of the statements that seemed controversial at the time have since appeared as forms of public policy. For example, the First Annual Report of the Science Council⁽²⁾ of June, 1967, states:-

"It is evident from this broad summary that the scale of support for science in Canada is relatively small as compared with that in most developed countries, and that the balance of spending in Canada differs from that in other countries."

and later in the same report,

"We must be sure that enough of our research and development effort is successfully directed toward profitable projects to ensure the continuity of the production which supports all our research. If our industry becomes unprofitable there will be no money for any kind of research."

The President of the National Research Council, Dr. W. G. Schneider, reiterated this theme, as follows:-⁽³⁾

"A major expansion in industrial research and in our industrial development generally now is imperative and must be given a very high national priority. Finally, consideration must be given by the Science Council of Canada to identifying priority areas in industrial research in order to develop programs in keeping with national objectives".

It is hoped that the material presented hereafter will be of constructive assistance to the Science Council, to the National Research Council, to the Special Senate Committee on Science Policy and to governments in developing such programs. Neither the first report nor this study are to be interpreted in any way as being inhibitory to the support of basic research in Canada. Their objective is entirely to strengthen the exploitation of such basic research. In so doing, the contribution of the individual can have greater impact on our national prosperity and well-being.

2. Selection Considerations

A national objective can be directed predominantly towards a social goal, or predominantly towards an economic goal, or it may have elements of both of these. Before making any selection of objectives therefore, it would seem fitting to consider whether the emphasis should be on social, or on economic goals, or on some combination of these. The Science Council⁽⁴⁾ has put this forward in an analogous but slightly different manner by listing six National Goals as basic to the establishment of national science policy. These are:-

1. National prosperity.
2. Physical and mental health and high life expectancy.
3. A high and rising standard of education, readily available to all.
4. Personal freedom, justice and security for all in

a united Canada.

5. Increasing availability of leisure and enhancement of the opportunities for personal development.
6. World peace, based on a fair distribution of the world's existing and potential wealth.

Of these, the first is clearly an economic goal. The last three are predominantly social goals, while items two and three have elements of both economic and social goals. The Science Council does not give any different weighting to these various goals, but uses them as a general framework for policy-making. The question, however, is pertinent, for if goal number three on education were held to be of first priority, a massive developmental program to improve the quality and availability of education should then ensue as a national technical objective. This would include investigations of new methods of teaching, of teaching in the home, of the use of new communication media, such as, an educational space satellite, the development of new teaching machines and the like. From this would come the improvement sought, plus a fall-out of a host of new devices and schemes, many of them of commercial value for manufacture and sale. Since education itself is now probably the largest dollar volume industry in the world, its economic significance as a business becomes apparent as well.

To develop a weighting for economic versus social goals, therefore, it is useful to examine briefly our national economic scene, as presented hereafter.

3. National Productivity

It is the gross output of goods and services that sets the standard of living of a nation. It is this that, in the end, determines salaries, wages and social benefits. Tables 1 and 2* show the Canadian output of goods and services, or gross national product since 1910. These

Footnote: * The Swedish productivity is shown also, to follow the arguments developed in the first document⁽¹⁾.

data show that Canada has a chronic productivity problem relative to our neighbour, main competitor, and social standards setter, the U.S.A. As shown in Chart 1, in 1910 the American produced sixty-two dollars more of goods and services than a Canadian. By 1968 he produced fourteen hundred dollars more. By and large, this difference now represents the extra car or coloured T.V. set that the American worker has over his Canadian counterpart. Over this span of time, improved communication in all forms has developed between the two countries. Simultaneously, the Canadian population has occupied a narrow strip along the U.S. border. This proximity, plus the now instant communication, has produced an increasing awareness of the economic disparity between the two countries, and an increasing consequent social restiveness. This, in turn, is emerging in terms of growing economic conflict between the provinces and the federal government; of growing pressures on the unity of the nation abetted by language and cultural differences; and of a spread of wage parity settlements, regardless of national output.

All of these pressures seem to be coming to a head. No other nation in the world faces such economic and social pressures, albeit benign. Mexico is buffered by major differences of language and culture as well as by a sparsely settled and inhospitable border. The future of Canada, as an independent nation, would unquestionably be more secure if all Canadians lived on the Edmonton latitude and spoke French exclusively. If the productivity gap with the U.S. continues to widen at present rates, it will hit \$3,000 per capita before the turn of the century. One can only speculate on what a difference of this size would do to the whole social fabric and unity of Canada. But the prognosis is unhealthy.

TABLE 1

GROSS NATIONAL PRODUCT DATA

| YEAR | GNP (Million) (\$U.S.) | | | POPULATION Million | | | GNP/CAPITA | | |
|------|---------------------------|--------|---------|-----------------------|--------|--------|------------|--------|--------|
| | Canada | Sweden | U.S.A. | Canada | Sweden | U.S.A. | Canada | Sweden | U.S.A. |
| 1910 | 2,235 | ----- | 35,300 | 7.0 | --- | 92.4 | 319 | ---- | 382 |
| 1950 | 16,550 | 5,560 | 284,800 | 13.7 | 7.1 | 152 | 1,209 | 794 | 1,875 |
| 1955 | 27,500 | 8,780 | 398,000 | 15.7 | 7.2 | 165 | 1,750 | 1,218 | 2,400 |
| 1960 | 37,400 | 12,330 | 503,700 | 17.9 | 7.5 | 179 | 2,090 | 1,650 | 2,810 |
| 1965 | 48,300 | 21,200 | 683,900 | 19.6 | 7.69 | 194 | 2,465 | 2,760 | 3,520 |
| 1966 | 53,450 | 22,900 | 743,300 | 19.9 | 7.77 | 196 | 2,680 | 2,945 | ... |
| 1967 | 57,500 | 24,600 | 785,000 | 20.4 | 7.84 | 198 | 2,820 | 3,140 | 3,... |
| 1968 | 62,900 | 27,300 | 887,750 | 20.9 | 7.95 | 201 | 3,010 | 3,435 | 4,... |

Note:- GNP at Market Value, as obtained from the Governmental Statistics Offices.

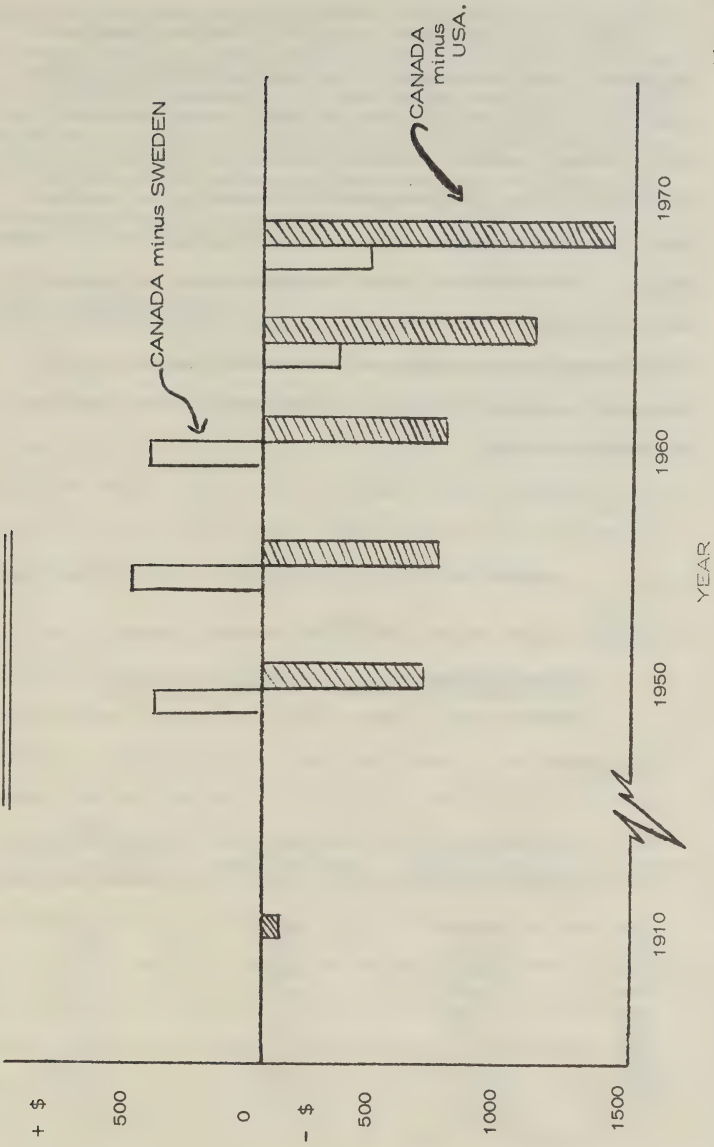
TABLE 2

DIFFERENCE IN GNP/CAPITA

| YEAR | Canada-Sweden | Canada-U.S.A. | Sweden-U.S.A. |
|------|---------------|---------------|---------------|
| 1910 | --- | -62 | ----- |
| 1950 | +415 | -666 | -1,081 |
| 1955 | +532 | -650 | -1,182 |
| 1960 | +440 | -720 | -1,160 |
| 1965 | -295 | -1,055 | -760 |
| 1966 | -265 | -1,110 | -845 |
| 1967 | -320 | -1,140 | -820 |
| 1968 | -425 | -1,410 | -985 |

Chart 1

THE PRODUCTIVITY GAP



Mar. 69
R.C.Q.

4. National Employment

Within ten years there will be half a million Canadians of the working force unemployed. This bald statement follows both clearly and cruelly from the data in Table 3, assuming there is no major change in national economic policy in the interval. For the period 1950 to 1968, the average annual unemployment rate was 4.6%. But for the period 1960 to 1968 this average rate had climbed to 5.2%. There seems no logical reason therefore to conclude that the unemployment rate for the next ten years should not fall somewhere between 4.6% to 5.2%. At these levels, and at current population projections, there must, therefore, be half a million unemployed by 1979.

TABLE 3.

EMPLOYMENT/UNEMPLOYMENT PICTURE

(Thousands)

| <u>YEAR</u> | <u>TOTAL CDN. LABOR FORCE</u> | <u>NUMBER UNEMPLOYED</u> | <u>% OF LABOR FORCE UNEMPLOYED</u> |
|-------------|-----------------------------------|------------------------------|--|
| 1950 | 5,163 (1) | 186 (1) | 3.6 (1) |
| 1955 | 5,610 | 245 | 4.4 |
| 1960 | 6,411 | 446 | 7.0 |
| 1965 | 7,141 | 280 | 3.9 |
| 1966 | 7,420 | 267 | 3.6 |
| 1967 | 7,694 | 315 | 4.1 |
| 1968 | 7,919 | 382 | 4.8 |
| 1970 | 8,350 (2) | 417 (3) | 5.0 (3) |
| 1975 | 9,545 | 458 | 4.8 |
| 1980 | 10,698 | 513 | 4.8 |

(1) D.B.S. Cat. 71-001, December, 1968, "The Labor Force"

(2) From Economic Council - 4th Annual Review, Pg. 72

(3) Projected by E.I.C. The data for the periods 1950/55, 1955/60, 1960/65 are not shown, but were used in calculating the averages for projections.

Of all the social problems, unemployment, with attendant poverty, is the most grievous. Indeed, many other social ills rise from this. Pollution control, water resources development and the like, are of little personal consequence to the unemployed. Again, one can only speculate on the effect of an unemployed work force of this magnitude on the whole social fabric and unity of Canada. But here too the prognosis is unhealthy.

5. The Priority Decision

Because of our deteriorating competitive position in national output relative to that of our omnipresent neighbour, the U.S.A., and because of our chronically high unemployment situation, it seems logical that national objectives of a predominantly economic, or job-generating nature, should take precedence over those of a predominantly social nature at this time in our national history.

As it happens, perhaps fortuitously, all the social objectives of interest to Canada are much more pressing in the U.S.A., because of their greater population density. The solutions to atmospheric pollution from the automobile and the aeroplane, for example, will be developed in the U.S.A., not in Canada, because they must have such solutions well before we must have them. This applies also to most other forms of pollution, and for urban blight, and for water resources management. It would seem prudent, therefore, for Canada to husband its limited developmental resources and to simply exploit the expertise proven in the U.S.A. and elsewhere for these social goals. Pollution control, in any case, will depend ultimately on legislation and compulsion, as is now evolving. For air pollution, the U.S.A. is being divided into 32 air quality regions, in accordance with the Federal Clean Air Act of 1967. Under this Act the government publishes air quality criteria for each region, then issues procedures for controlling the pollutants involved. The recently formed U.S. Federal Water Pollution Control Administration

is expected to develop analogous approaches for water pollution. Thus, we need only apply successful American pollution legislation to our Canadian conditions. Furthermore, our unequal competitive position demands that Canadian industry never bears heavier legislative controls than its American counterpart. Our vital paper industry, for example, could not survive under a ten dollar a ton charge for pollution control if this same cost were not being borne by its American competitor. This is the kind of situation that now apparently faces the Canadian Shipping industry. Canadian legislation is being drafted to define responsibilities and liabilities for water pollution arising from spilled cargo or fuel in Canadian waters. This is being patterned after U.S. legislation, but with greater liabilities and responsibilities being placed on the carrier in the Canadian plan. This, in turn, will force up insurance costs for Canadian carriers and make them less competitive than their U.S. counterparts. It could also divert cargoes from Canadian ports. This is not conducive to strengthening our national competitive posture, even though the most rigid pollution control attainable is obviously socially desirable.

Such a bread and butter approach to pollution control, via legislation, would then permit us to concentrate our resources on those national technical objectives which offer the best hope of improving our competitive posture and thus our national prosperity.

6. The Survey of Industrial & Engineering Views

Like the rabbit explosion in Australia, or the chain reaction of nuclear energy, briefs and papers on science policy and objectives are proliferating in Canada. This is the healthy sign of an aroused technical community. To be as useful as possible in this situation, and to provide some, hopefully, new information, an effort was made to catch the sense of the industrial and commercial world on the topic of national objectives. This was done by soliciting views, in writing,

directly from the heads of most of the major enterprises in Canada, from industry to banks to newspapers. At the same time, notices were placed in technical journals inviting personal statements from individuals. Governmental research laboratories and academic institutions, except for the Schools of Engineering, were not, however, canvassed, as this was meant to be an opinion from the industrial, commercial, and engineering fields. Any such opinion must, therefore, still be integrated with those of the academic and governmental fronts.

The responses received are reported in abbreviated form in the Addendum. These are for the period October, 1968, to March, 1969. Some of these, as recorded, are the different written views of several people in one organization. The frequency of citation of various suggested items is as follows:-

| | | |
|-----|-------------------------------------|----------|
| 1. | Transportation, in all forms | 30 times |
| 2. | Improved Incentives | 19 " |
| 3. | Resource development | 17 " |
| 4. | Urban development and housing | 15 " |
| 5. | Miscellaneous | 13 " |
| 6. | Communications | 12 " |
| 7. | Pollution | 12 " |
| 8. | Water resources development | 11 " |
| 9. | Northern development | 10 " |
| 10. | Energy utilization and power plants | 10 " |
| 11. | Computer Technology | 10 " |
| 12. | Agriculture and food | 9 " |
| 13. | Weather control | 8 " |
| 14. | Oceanography | 5 " |
| 15. | Nuclear power | 5 " |
| 16. | Education | 5 " |
| 17. | Health | 3 " |
| 18. | Service industries | 2 " |

These can be compared with the national objectives put forward by the Science Council and which were listed by the Council in the following general order of priority: (4)

1. Canada's Interests in Space
2. Water Resources Management and Development
3. Transportation
4. Urban Development
5. Computer Applications
6. Scientific and Technological Aid to Developing Countries
7. Health Care Delivery System
8. Economic Development of Canada's North
9. The development of Energy Sources
10. Integrated Resource Management
11. Oceanography
12. Weather Control

The overlap between the two lists is clear. The difference lies in the relative weighting assigned by each group to the various objectives. There is no doubt but that different groups will have different philosophies and therefore reach different weightings for the same objectives. This is not only logical, but correct and necessary for society. The priorities assigned by this Committee of the Engineering Institute of Canada, according to its philosophy, are thus developed in the next section.

7. The National Objectives

Because of pressing national economic considerations, and because of our limited resources, this report favors predominantly economic goals over predominantly social goals at this time in our national history. If this is accepted as the first selection criterion then all suggestions from the Survey and the Science Council can be split into two priority classes as follows, but in no order of priority within the class.

- Transportation
- Resource Development (excluding water)
- Improved Incentives (not truly an objective, but a means of reaching the objective)
- Northern Development
- Communications (including space satellites for communication)
- Weather Control
- Agriculture and Food
- Energy Utilization and Power Plants
- Computer Technology
- Oceanography
- Education
- Nuclear Power
- Service Industries

- Urban Development and Housing
- Water Resources Development (essentially pollution control in the context of this study)
- Pollution
- Health
- Scientific and Technological Aid to Developing Countries

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Once started, on the massive scale required to be effective, we become locked into the project for a minimum of seven years, and probably ten. It is fruitless to expect the targets to be reached earlier. If lesser time spans are anticipated by the funding bodies, then the projects should not be started. The awesome U.S. "Man-on-the-Moon" project, for example, was launched in late 1957, following Sputnik One of October, 1957. The Americans are now expected to be on the moon in 1969 or 1970. This is a year ahead of schedule. They have already been around the moon in 1968. Thus, this U.S. national objective will have a time span of twelve years by 1970, when the prime objective will apparently be reached. Because the end is in sight, and because of increasingly competitive demands on their resources for other projects, U.S. funding on the space project is quickly being reduced. This is as it should be. In the meantime, a whole new space industry has been developed; national (and world) security has been maintained; technological fallout has strengthened the competitive stance of the U.S. metallurgical, ceramic, non-ferrous metals, aeronautical, instruments, electronic, computer and chemical industries; and new non-space markets have opened up for such industries as a result of their participation in the project. From this background then, the various national objectives of a predominantly economic nature, open to Canada can be examined as follows:

1. Transportation

Dr. J. W. Hodgins, Dean of Engineering of McMaster University, sums up this topic in the Addendum in an incomparable manner when he states: "The one technological program which towers over all of the others in Canada in priority is the problem of a serious project on the national transportation.". From the Survey it is quite clear that Canada's industrial leaders share this view. There is an apt axiom - "Keep first things first". We can not launch a truly effective program in Northern Development unless we

can get in and get out of Canada's northland more efficiently than we now do. Nor can we really have a strong program on Resources Development without first strengthening our transportation resources in every way practical. One need only glance at the vast and forbidding expanse of Canada, as depicted on any map, and muse over its narrow population band along the U.S. border, to grasp that if Canada does anything best and cheapest in the world it must be in the transportation of people, products, power and services, for the nation to prosper in an even more competitive and technological world environment. Some idea of the gains possible can be gleaned from the knowledge that unit trains can reduce freight costs from their existing level of 0.9 cents per ton mile to 0.5 cents per ton mile, while solids pipelines would reduce this even more, to about 0.3 cents per ton mile. This Brief therefore recommends a major research, developmental and exploitation project on transportation in Canada, as the national objective of leading priority.

To satisfy our needs and unique geographic situation, it is reasonably evident that traditional techniques will not suffice for all problems. New approaches must be considered, including such general examples as:

a) STOL AND VTOL Aircraft

If Canada is to open up its smaller centers and northern reaches to rapid movement of men and materials, then air travel is the obvious method. None of such areas can, however, justify elaborate and expensive airports. The Short Take Off and Landing vehicle offers the best current hope for solution of such a problem. Besides markedly improving the flexibility of our Canadian transportation, major export sales for effective

second-generation STOL and VTOL units exist.

New York City, for example, is now planning to build a STOL port within three years on the Hudson River. The port would comprise a one thousand foot landing strip as the roof of a ten story building. Pan American World Airways Incorporated has put forward an alternative proposal for the same end, as a private venture. Mr. H.W. Seagrim, then Executive Vice President of Air Canada describes the value of the STOL and VTOL aircraft more fully in the Addendum. It happens that Canada's aircraft industry is particularly suited for the development of such planes, while it is not suited for the development of jumbo jets, for example. The Economic Council of Canada makes this point in its Fifth Annual Review when it states, ⁽⁵⁾ "Canadian industry has established a good position in such niches as the world market for certain kinds of specialized aircraft." Furthermore, success in this field could lead to increased employment in Quebec, where a chronic unemployment problem now exists, since much of the aircraft industry is located at Montreal.

b) Solids Pipelining

The potential of this technique for moving large volumes of materials more cheaply than by conventional railroading has been clearly established by liquids and gas pipelining. Such lines now move 282 million ton miles of matter a day, as compared to the 154 million ton miles of cargo a day carried by the Canadian Pacific Railway. The task at hand is to exploit this technique for moving wheat, potash, wood chips, sulfur, iron ore, coal and the like. Fortunately a very large amount of work has already been

done in Canada on this topic, covering solids pipelining in either slurry form or in encapsulated form.

c) Northern Development

It has been found that running heavy equipment over frozen muskeg eventually produces a deep trough, filled with water, in the summer. The finding might be exploited by developing high-speed muskeg barges for use in such muskeg canals in the summer, followed by snowmobile train use on the frozen canal in the winter. A network of usable muskeg canals could alter the whole transportation environment of Canada's northland.

d) The Ice Problem

Canada has ice-locked waterways from the St. Lawrence Seaway to Hudson Bay. Transportation over, through, or under the ice is thus a matter of particular importance to Canada. The hovercraft and the snowmobile are new approaches to over-ice transportation. New developments in ice-breaking such as the lifting-type ice-breaker nose, open up other vistas. Perhaps a properly designed submarine could be used as an ice-breaker also. In any case, submarine barging under ice is a possibility. Canada has one of the leading nuclear power establishments in the world, with leading raw material resources as well. It would seem reasonable, therefore, to consider if these factors could be linked, to develop under-ice transportation, powered by nuclear energy, to move grain, iron ore, potash and the like, from Churchill all year round and, similarly, through the Seaway all year round, where water depths permit. This case is put forward, most forcefully, by Professor Prestwich of McMaster University, in the Addendum, but for surface transportation. Canada, however, must

give priority to all year transportation, and this may require the under-ice approach.

Other possibilities exist but this list, however, is complete enough to indicate the scope, potential, and the cost of the project. In any case, an overall systems study should be done early in the project to set the pattern and priorities. If done on a scale analogous to the U.S. Man-on-the-Moon project, it would be truly a national undertaking.

2. Computer Technology

In no way is the computer unique to Canada. But the computer is so unique in its increasing impact on technology that it is fruitless for a country to hope to attain a leading role in any technology without a strong base in computer science. This point is covered well by Professor A. Porter of the University of Toronto, in the Addendum. Mr. R. C. Scrivener, President of Bell Canada, also stresses, in the Addendum, the need to maintain a high level of national competence in electronic circuitry. Computer science falls into two separate areas; hardware, or the computing machine itself, and software, or the materials and programs for the machine. There is also the so-called man-machine interface, or the input-output devices, where man and machine interact. It is not yet fully grasped that the whole software area of computer technology falls into the service field. Now the Economic Council of Canada states clearly and unequivocally that this is the area we must look to for more jobs, as it claims, (5) "The Canadian service industries now account to close to 60% of total employment, a proportion similar to that of the United States. In most countries, whether or not they are rich in natural resources, it is the service industries that appear to be growing most rapidly." . The newly appointed Délégué

Général to the National Research Council, Dr. L. G. Cook, says, similarly, (6) "The basic problem in getting a high growth rate in Canada's future economy implies shifting from the present ratio of industry that is involved in materials to a much higher proportion of technological black-box type industry."

This Brief therefore recommends a major research, developmental and exploitation project on computer technology in Canada, with emphasis on software and the man-machine interface, as a second national objective.

Some of the considerations involved here are discussed in the Addendum by Dr. A. D. Booth, Dean of Engineering of the University of Saskatchewan, and by Dr. G. L. d'Ombrain, Dean of Engineering of McGill University. Opportunities for making pronounced economic and social gains from such a program abound in:

a) Education

As several of the contributors to the Public Survey have noted, this is now big business indeed, and getting bigger every day. The potential advantages from an attack in depth in this field are manifold.

b) Communication

It is becoming evident that the communication systems of the immediate future will be digital. That is the message will be transmitted in pulses, instead of in a modulated wave as at present. Pulse transmission is, of course, the language of the computer. As communication is of vital importance to Canada, for the same reasons as in transportation, a program in computer technology oriented to communication would strengthen Canada's competitive position. An

interesting possibility is put forward also by the Vice President of Canadian Industries Limited, Mr. S. S. Grimley, who points out in the Addendum, that the development of a "black-box" to translate English into French and vice versa could become a tool to promote national unity, as well as a device of high domestic and foreign market potential. Language translation, via computer, is a project of unique importance to Canada. Success would also open up the whole field of direct voice communication to the computer. The sales opportunities here can only be described as fantastic.

c) Health Services

The latest generation of computers now under active development can store three trillion bits of information on a single sheet of paper 8-1/2" by 11" in size. For the first time, a man-made device can exceed the storage capacity of the human brain on a volume basis. The human brain can store only some ten billion bits of information. This is a major breakthrough in storage capacity, weight, and volume. Technological gains of this kind, plus a voice "translator", could make available entirely new worlds of health service. The deaf could be given an electronic ear, keyed to touch response. Health services could be brought to small or distant centres, by coupling a nurse and a medical analyst (a technologist) to a remote computer. Personal data compiled by the nurse, augmented with analytical data obtained by the analyst on body fluids, brain function, heart function and by X-rays, as now routinely available from existing instruments, could be fed to the computer for storage and diagnosis.

Treatment recommendations could be **relayed back directly** by the computer, or via a consulting medical doctor, to the originating centre. In this way the medical profession would become able to channel its limited resources into surgery, psychiatry and research, the areas which now appear to be of most concern to the profession. At the same time, health service could be provided for the hundreds of Canadian centers now without a physician.

These are only a few of the specific applications available to a major program on computer science, with emphasis on the man-machine interface and software. Along with this would develop an increased national awareness of computers and their value. This, in turn, would help ensure that Canadian business, academic institutions and governments were among the most advanced, technologically, in the world, with the improved competitive position that this would bring.

3. Communications

The interrelationship between communication and the digital language of the computer has already been noted. Thus a computer project inevitably involves a communication program. Beyond that, this Brief supports very strongly the recommendation of the Science Council that Canada should move immediately, via space satellites, to occupy those space corridors and transmission channels that are needed to give Canada its own communication system from space. The feasibility and desirability of such a system has now been established beyond question. The magnitude of our communications problem is shown most dramatically by Charts 2 and 3, as provided by the Canadian Broadcasting Corporation.⁽⁴⁾ These show how Canada embraces Japan, Great Britain, France and Italy in size, plus a few other countries as well.

CHART 2.

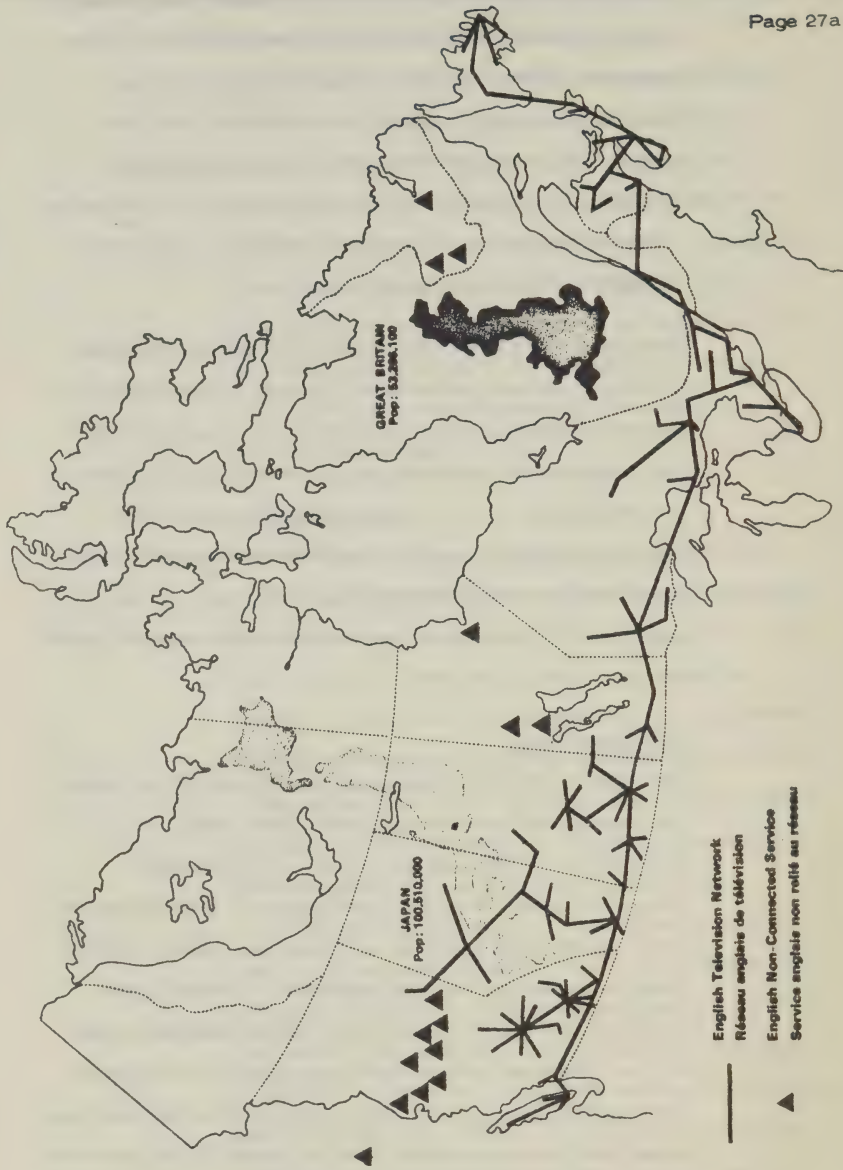


CHART 3.

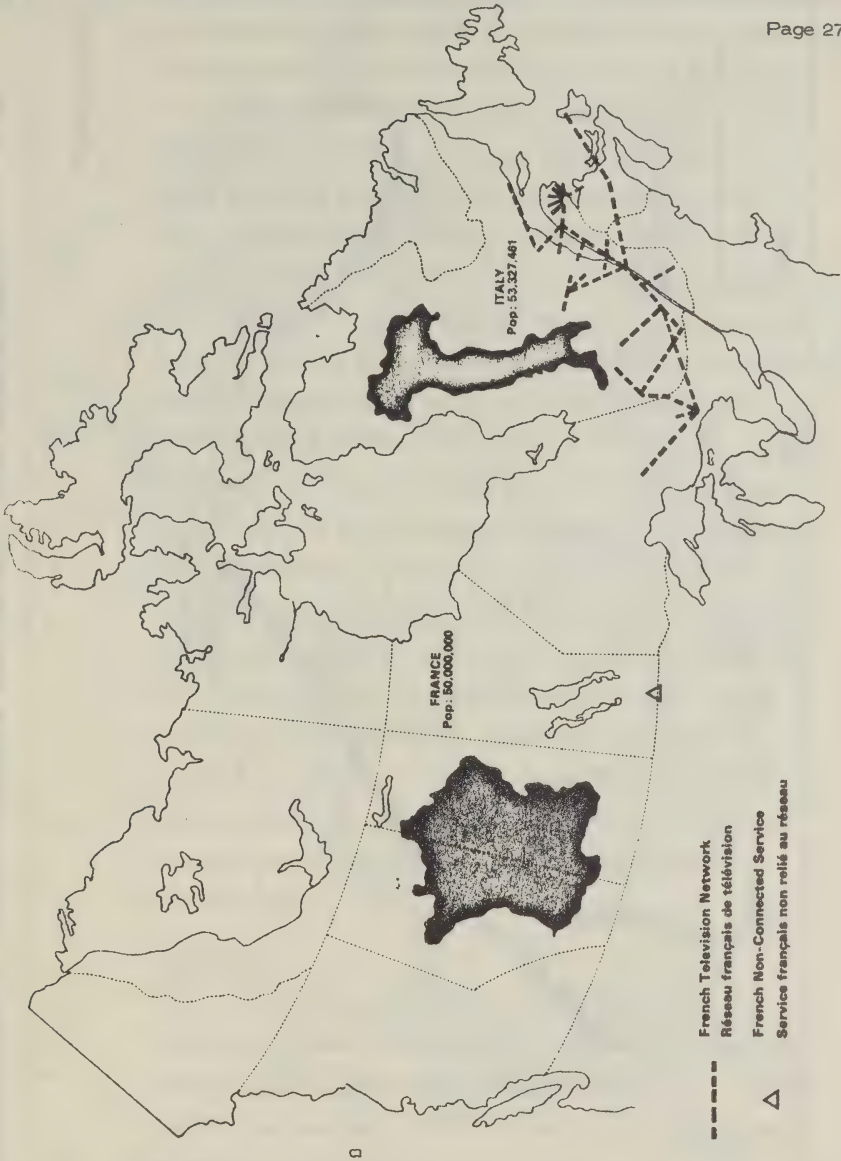
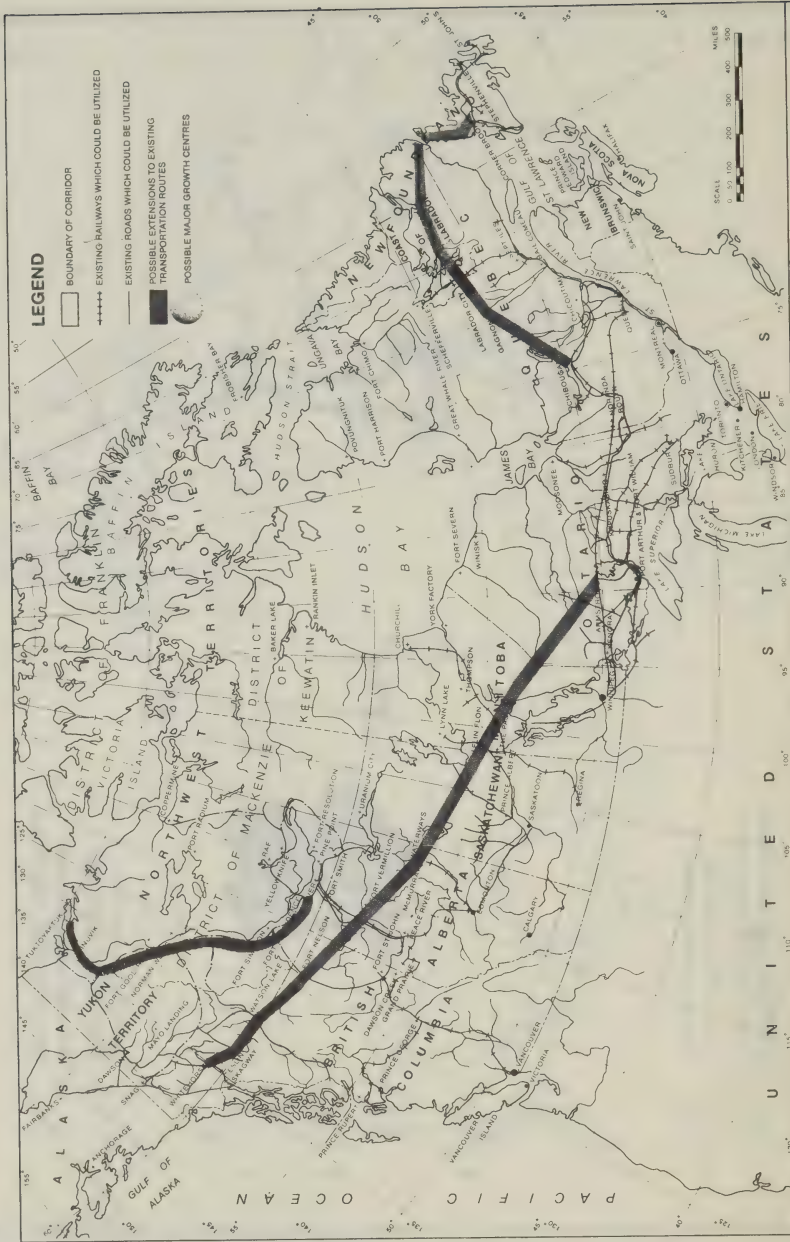


CHART 4



ACRES RESEARCH AND PLANNING LIMITED

DEVELOPMENT CORRIDOR: IMPLEMENTATION

JUNE 1987

21

6. Service and Construction Industries

As stated earlier in this Brief, the service sector is now the most important sector of the economy. Yet where has this fact been woven into national policy? Lost in the eerie quiet of nuclear energy, the roar of space projects, the drip, gurgle and whine of complex laboratory experiments, who can hear the small cry from Mr. J. Nestor, Research Manager of Dominion Stores as he notes in the Addendum - "Since more and more of the gross national product is being devoted to building up the wealth of the non-productive elements, i.e. the distributive segment of the economy, I feel that at some point this has to be recognized.". This Brief recommends, therefore, that the special needs of the service sector form a prime part of the Transportation Project and the Computer Technology Project. Similarly, the special needs of the Construction Industry should form a prime part of the Transportation and Computer Projects. The Construction Industry now accounts for 20% of the gross national product. Before the end of the century the total value of all construction in Canada is estimated to double that existing today. Like the service industry, the construction industry is fragmented and diffuse. The two industries, therefore, require parallel consideration.

7. Education

Since the potential applications of the computer to education are almost endless, and because of the enormous and growing world-wide dollar volume in education, this Brief recommends that one important part of the Computer Technology Project be devoted to the educational field.

8. Nuclear Power

This Brief suggests that another part of the Transportation Project consider the application of nuclear power to under-ice or through-ice transport. The potential overall merit to

Canada's particular geography, climate and nuclear resources is obvious.

9. Oceanography

Canada has one of the longest shore-lines in the world. Thus, Canada must eventually achieve a position of prominence in oceanography and all that this implies. But the bulk of this shore-line is ice-bound the bulk of the year. The Committee believes, therefore, that the priority here should be given to the development of under-ice transport techniques as part of the Transportation Project. There are some potentially interesting interactions between Oceanography and Weather Control which are mentioned briefly under Weather Control.

10. Resource Development

One of the objectives of the Transportation Project would be to strengthen our resource industries. Solids pipelining is one example here. A pipeline system that could transport, wood chips, potash, or metal ores, has obvious significance. Economical under-ice or through-ice transport is the limiting factor at present for developing the huge high-grade iron ore deposits on Baffin Island. These rocks contain 68% iron ore, the richest in the world, in a billion ton lode.⁽⁹⁾ Lack of such facility is also hindering the development of the Ungava Peninsula for nickel and asbestos. Now the full potential of the under-ice or through-ice transport scheme becomes clearer. Beyond this, resource development could be strengthened by federal and provincial legislation requiring all geological data such as drill cores, assays, field data, air photos and the like for all geological ventures in Canada to be deposited, within ten years of completion in a central geological bank, such as a Canadian Geoscience Data Institute owned and operated by industry as a cooperative venture, under federal and provincial legislation. This is an

extension of the optional scheme suggested in 1967 by the National Advisory Committee on Research in the Geological Sciences (13). As long as it is optional, it is doubtful that much will come of the scheme. Through such an Institute, a national geological map could gradually be built up. Promising geological areas could then be auctioned off, for all purposes, precisely as they are now done for petroleum exploration. Only from such a national bank of data can the power of the computer be exploited. This would help satisfy the requests from Dr. W. H. Gauvin, Research Manager of Noranda and from Mr. D. D. Thomas, President of Sheritt Gordon Mines Limited, for "Scientific aid to develop more efficient systems for mineral exploration.". This might be supplemented by radically new drilling techniques, perhaps by coupling oxygen or fluorine with a laser beam and a mass spectrometer for the volatilization and instant assay of rock. With such a device feeding data to a computer bank along with other geological data on a national scale, a detailed geological grid could be built up in a reasonable period of years. If such approaches were to be adopted by industry and government, then another aspect of the Computer Technology Project could be devoted to mineral exploration and resource development. Few other concepts offer more hope for increasing Canada's efficiency in mineral and hydrocarbon exploration than the Canadian Geoscience Data Institute scheme proposed in 1967.

11. Weather Control

All of Canada could benefit from some form of constructive weather control, if attainable. This is why extensive work has already been carried out, for such problems as rain and hail control. Both agriculture and the forest products industries stand to gain from such activities. The forest products industry is first among Canadian industries. It

employs 300,000 people and produces revenue of about \$3.5 billion per year, over half of which is from exports. The industry accounts for more than one quarter of Canada's total export trade. One particular competitive problem this industry is now facing to an increasing extent, as Dr. A. Vroom states in the Addendum, is the faster rate of growth of trees in the U.S. south due to the warmer climate there. Indeed, some Canadian companies, such as Abitibi, and Price Bros., have now set up operations in the U.S. southland to ensure their international survival. From this viewpoint then, efforts to try and warm up Canada's climate take on an added incentive. Here the oceanography of our Arctic waters may be a factor. Russian scientists have claimed⁽¹⁰⁾ that damming the Bering Strait and pumping through it could lead to a recovery of the previous warmer climate in the Arctic basin. Other climatologists argue, however, that any reduction of the Arctic ice-cap would lead to a few thousand years of warming followed by an Ice Age. A more immediate problem would be the effect on precipitation and water levels caused by any melting of the Greenland ice-cap. The advantage of the dam and pump scheme, however, is that the warming could be controlled, or reversed if necessary, to manipulate the forces of Nature. There might be something to gain, for example, if the Greenland ice formation was stopped and stabilized. At least the birth of icebergs would cease. Similarly, if the Strait of Belle Isle were dammed to prevent the periodic influx of the cold waters of the Labrador Current, the waters of the Gulf of St. Lawrence might be raised as much as 4°C. in average temperature. This would also provide a bridge between Newfoundland and the mainland, with improved access to the riches of Labrador. Again, a causeway might be built out into the Atlantic Ocean from the tip of Newfoundland to trap and divert a greater portion of the warm Gulf stream into Canadian Maritime waters.

Alternatively, nuclear-powered submerged pumps could be used. Clearly, Canada has not yet faced up at all to its possibilities. To maintain perspective, the proposed causeway to Prince Edward Island, an admitted engineering practicality, would cross the Northumberland Strait, for a length of nine miles, with an average water depth of sixty feet. The Strait of Belle Isle is twelve miles across, with an average depth of two hundred and fifty feet. The Bering Strait is forty-five miles across with an average depth of one hundred and fifty feet. This Brief does not recommend a major project on this topic but it does suggest that, in due course, a feasibility study be carried out on the oceanography of Arctic waters. No other foreseeable technical step could have more long range impact on Canada's future than control of its Arctic climate.

12. Agriculture and Food

It has been estimated that 40% of the new products to be developed over the next ten years will be processed foods. This Brief suggests, therefore, that national projects on Transportation and Computer Technology would make Canada's competitive possibilities in this area more attractive, by strengthening distribution and service facilities.

13. Summary

In summary, the National Objectives recommended herein, for the concrete reasons disclosed, are:

1. TRANSPORTATION

- a) Special purpose aircraft (short and vertical take-off and landing vehicles).
- b) Service industry applications (expanded containerization, etc.).
- c) Resource industry applications (solids pipeline, etc.).

Special Committee

- d) Electric power transmission (superconductivity, etc.).
- e) Construction industry applications (akin to the Service industry).
- f) The ice problem (hovercraft, submarine barging, etc.).
- g) Northern development (permafrost treatment, muskeg canaling, etc.).

2. COMPUTER TECHNOLOGY

- a) Education
- b) Service industry applications
- c) Communication
- d) Health service applications
- e) Resource industry applications
- f) Construction industry applications

It is stressed here that both of these projects have already been listed by the Science Council as National Objectives.

This Brief recommends further that:-

1. Canada immediately occupy, by space satellites, those space corridors and transmission channels needed to provide an adequate national communication system from space, as urgently recommended by the Science Council.
2. Legislation be enacted to promote the formation of a Canadian Geoscience Data Institute owned and operated by industry to collect geological data for all geological work carried out in Canada, in a compulsory but cooperative manner acceptable to industry, and that a detailed national geological grid then be developed, using the power of the computer.
3. An appropriate body be invited to carry out a feasibility study of the control of climate via the oceanography of Arctic waters.

8. The Innovative Process

It is fruitless to launch national programs in science and technology unless the total Canadian environment is conducive to exploitation of the technological fallout that would ensue. This point is made clearly in the Addendum by Dr. E. R. Rowzee, President of Polymer Corporation, when he states, "In the realm of national science policy it is my belief that a more pressing subject than national objectives is a realistic analysis of how to encourage total and profitable innovation in the private sector.". The environment needed has been explored in a detailed study by the U.S. Department of Commerce, the Charpie Report⁽¹¹⁾. Table 4 from this work shows how cities vary in their formation of new businesses.

TABLE 4.VARIATIONS - CITY TO CITYIN THE PROPENSITY TO GENERATENEW TECHNOLOGICALLY BASED COMPANIESMANY SUCH COMPANIESFEW SUCH COMPANIES

Boston

Philadelphia

Palo Alto

Chicago

Washington, D.C.

Kansas City

Pittsburgh

Atlanta

Table 5 from this work gives the findings of this group on why these cities vary in their formation of new businesses.

TABLE 5.

THE TOTAL ENVIRONMENT

- A. Institutional and individual venture capital sources that are (I) "at home" with technologically oriented innovators and (II) have the rare business appraisal capabilities necessary to diagnose the prospects of translating a technical idea into a profitable business.
- B. Technologically oriented universities, located in an area with a business climate that encourages staff, faculty, and students to study and themselves generate technological ventures.
- C. Entrepreneurs, who have been influenced by examples of entrepreneurship (for it is our contention that entrepreneurship breeds entrepreneurship).
- D. Close, frequent consultations among technical people, entrepreneurs, universities, venture capital sources, and others essential to the innovative process.

Table 6 from this study shows that it is frequently the small operator that sparks off the innovation chain, even today in our multi-million dollar R. & D. environment.

TABLE 6.THE SIGNIFICANCE OF SIZE

.....Professor John Jewkes, showed that out of 61 important inventions and innovations of the 20th century, over half of them stemmed from independent inventors or small firms. Professor Daniel Hamberg of the University of Maryland studied major inventions made during the decade 1946-55 and found that over two-thirds of them resulted from the work of independent inventors and small companies.

.....Professor Merton Peck of Harvard studied 149 inventions in aluminum welding, fabricating techniques and aluminum finishing. Major producers accounted for only one of seven important inventions.

.....Professor Hamberg also studied 13 major innovations in the American steel industry -- four came from inventions in European companies, seven from independent inventors, and none from inventions by the American steel companies.

.....Professor John Enos of the Massachusetts Institute of Technology studied seven major inventions in the refining and cracking of petroleum -- all seven were made by independent inventors. The contributions of large companies were largely in the area of improvement inventions.

Table 7 gives the conclusion the U.S. group reached on this matter. To savor the full flavor of this statement, one should realize that R. A. Charpie is the President of Union Carbide Electronics, while the members of his Committee included the senior executives of other large U.S. Corporations like Celanese Corporation, Xerox, Schenley Industries, C.B.S. Corporation, Bell and Howell Company.

TABLE 7.

SIZE EFFECT CONCLUSION

From a number of different points of view, we are persuaded that a unique cost-benefit opportunity exists in the provision of incentives aimed at encouraging independent inventors, inventor-entrepreneurs, and small technologically based businesses. The cost of special incentives to them is likely to be low. The benefits are likely to be high.

This size effect is also supported, in part, by a look at who has exploited the findings of the National Research Council and the Defence Research Board in Canada, given in Table 8, as collected from the hearings of the Senate Committee on Science Policy⁽¹²⁾.

TABLE 8.

EXPLOITATION OF SOME GOVERNMENT RESEARCH

| <u>AGENCY</u> | <u>ITEM</u> | <u>ESTIMATED SALES</u> |
|---------------|--|----------------------------|
| D.R.B. | Airborne Doppler - Canadian Marconi - | \$100 Million |
| D.R.B. | Digital Flight Simulator - C.A.E. Industries - | \$ 18 Million |
| D.R.B. | Stol Aircraft - De Havilland | |
| D.R.B. | Turboengine - United Aircraft of Canada - | \$500 Million |
| D.R.B. | Integrated Circuits - Northern Electric | |
| D.R.B. | Ferrite Powders - Ferroxx Iron Limited | |
| N.R.C. | Potentiometer - Guildline Limited | |
| N.R.C. | Crash Indicator - Leigh Instruments - | \$ 15 Million |
| N.R.C. | Magnetometer - C.A.E. Industries - | \$ 9 Million |
| N.R.C. | Altimeter - Leigh Instruments | |

Another interesting point from this table is that the work involved is mainly in transportation and electronic instrumentation. This strongly supports the contention of this Brief that Canada should specialize now in transportation and computers. It is a military axiom to reinforce strength, to achieve breakthroughs, and this record shows that these governmental research agencies have been far more successful in transportation and electronics than elsewhere.

Now it happens that two-thirds of Canada's manufacturing economy is controlled by foreign ownership. It also happens that for one reason or another, the statistical facts show that Canadian industry and commerce in gross is not investing the same proportionate amount of the sales dollar in the development of new technology as its foreign competitor. Given this background, as a national fact of Canadian life, plus the findings of the Charpie Report, it makes good economic sense to try and find and support that independent Canadian innovator who is left, the small private inventor. This might be done through legislation, such as a Small Inventors Act. In this Act the federal

government would guarantee the first \$150,000 of money loaned by a financial institution to an inventor-entrepreneur to explore and exploit a new concept, in the same manner as it now guarantees loans for house building. Similarly, the total fund could be administered by a federal agency but loaned out by the financial institutions, at their discretion and not at that of the federal agency. Eventually, the agency would assume greater indirect control by funneling more of the available funds to those financial institutions with the best record of successes in project selection, based on commercialization of the idea. The Charpie report makes it utterly clear that our financial people must become far more intimately involved than they now are in the innovative process. Thus they, and not the federal agency, must make the loan decision, in consultation with the applicant, and with such outside technical advice as the financial institution might see fit to solicit. Anyone who has attempted to screen unsolicited inventions from the "outside" is acutely aware of the intense difficulties involved. But these must be met and mastered, to find the gems among the dross. We need have no fear of Canadian financial institutions, particularly the banks, being unduly liberal in their use of risk capital. The inherent and inbred caution of the Canadian banker is all the control that is needed. The cut-off limit of \$150,000 is proposed as this should be enough to demonstrate the technical feasibility or not of a scheme. It would provide a good three man years of experimental work for example. This could be done by the inventor himself, or farmed out by him to an industrial or provincial research institute, or to an academic group. The additional and larger sum required to bring a promising scheme through the developmental stage into commercialization would then have to be provided by the financial institution either as an unguaranteed risk loan, or as an equity investment, or from the public via a share offering, or the like. This Brief maintains that a Small Inventors Act is far more vital to Canada than to any other country, because of the particular and unique nature of the Canadian economy. It is a modification of the Act establishing the National Research Development Corporation of the United Kingdom, which finances governmental, academic, industrial

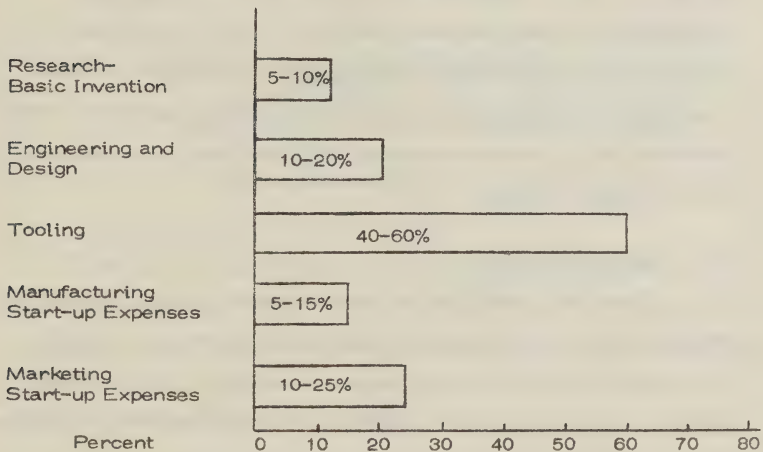
or private inventions to commercialization.

9. Incentive Programs

The existing governmental incentive programs to promote new technology are a definite gain, as is evident from the industrial comments in the Addendum. The Addendum makes it also clear that they are not yet completely adequate. Both the President of Stelco, Mr. H. M. Griffith, and the President of Molson Industries, Mr. D. G. Willmot, put this bluntly indeed when they claim that tax incentives would be more fruitful than direct research aid. In good part this is because the major cost of the innovative process falls not in the initial concept stage, but in the implementation stage, as shown in Table 9, again taken from the Charpie Report.

TABLE 9.

TYPICAL DISTRIBUTION OF COSTS IN SUCCESSFUL
PRODUCT INNOVATIONS



These costs, with attendant risks, are particularly grave in large volume operations as in the chemical, pulp and paper, mining and metallurgical industries. At present there is a three year tax abatement on

the profits from mining and petroleum exploration. The economic and incentive value of this is established from the evidence. The proof is there for all to see, in new mines, new oil and gas wells, new communities, new jobs. Yet a new manufacturing idea often becomes obsolescent faster than a new mine becomes depleted and it can also bear a much higher risk of failure than a mine. The E.I.C. submits, therefore, that few steps would stimulate the Canadian innovative process more than a tax abatement on the first three years of profits arising from a new concept invented and worked in Canada. Economists might argue that this would entail a loss of tax revenue. But there is no tax revenue from new operations that are not started because of lack of sufficient incentive. Furthermore, tax revenues accrue immediately from the wages and salaries paid to employees in the operation, even when the operation is still running at a loss in the start-up and run-in phases. This Brief recommends as strongly as possible, therefore, that such an incentive scheme be added to those now in existence. Thus this is a supplementary scheme and not a replacement scheme. Few steps could induce subsidiaries to strengthen their own innovative teams more than the knowledge that they had an improved hope to recoup costs in a Canadian operation. Beyond this, they could still have the bonus of secondary profits from operations set up outside of Canada where desirable, from the know-how developed in Canada.

10. Technical Manpower

There have been fears expressed recently by both the National Research Council and Canadian industry that Canada may soon be producing more highly-trained people, to the Ph.D. level, than the economy can absorb, that is, employ. This Committee does not share this view. We cannot produce too many of such people. But we must increase their job opportunities in Canada and we might have to be more selective in what academic manpower areas are supported, to minimize having too many graduates of one kind and not enough of another. This is one purpose behind the National Objectives, the Small

Inventors Act, and the Tax Abatement Plan, suggested by this Brief. As Table 10 shows, we have a long way to go yet to match the technical manpower of those countries who now outproduce us, Sweden and the U.S.A. Although these data are for 1963, the relative positions can not be greatly changed yet. As long as an American has 1.7 more years of education than a Canadian, as he now has, then we cannot reduce our national investment in education.

TABLE 10.

TECHNICAL MANPOWER IN 1963

| <u>COUNTRY</u> | <u>ENGINEERS AND PHYSICAL SCIENTISTS PER 10,000 POPULATION</u> |
|----------------|--|
| INDIA | 2.4 |
| UNITED KINGDOM | 33.2 |
| U.S.S.R. | 48.1 |
| CANADA | 48.9 |
| UNITED STATES | 61.7 |
| SWEDEN | 63.5 |

Refs: 1. "Goals of Engineering Education",
E. A. Walker et.al., Am. Cos. for Eng.Educ.
January, 1968.
2. Department of Manpower & Immigration, Ottawa.
May, 1968.

11. The Overall Cost

The most value in suggesting new programs comes if some idea of costs is provided. This is by far the most difficult and least definitive part of this Brief. First-order or ball-park estimates only can be given.

These are based on the following considerations:

1. It costs \$35,000 per year to support one professional person in research and development.
2. The present annual federal governmental support to industrial R. & D. is \$70,000,000.

3. The National Objectives would be funded for 10 years, with detailed reviews after the fifth and seventh year and annually thereafter.
4. Funding would increase as programs move from the less costly concept stages to the more costly implementation stages, at a ratio of 10% per year for the first 4 years, 20% for the next 3 years, and 30% for the following 3 years. These ratios would apply only to the National Objectives and not to monies for the Small Inventors Act. These latter would increase at 3% per year, in keeping with the economy, or be stabilized as desired.
5. 75% of the projects selected for financing by the financial institutions under the Small Inventors Act would fail, resulting in a net cost to the government.
6. 25% of these projects would succeed, but repayment of indebtedness would not start until 7 years after the initial loan. Gross tax revenues from these successes are then estimated to carry the whole program, making it self-sustaining.

From these factors, Table 11 has been derived for projected costs.

TABLE 11.

PROJECTED PROGRAM COSTS

| Year | National Objectives | | Small Inventors Act | Annual Total |
|--------|---------------------|---------------------|---------------------|---------------|
| | Transportation | Computer Technology | | |
| 1 | \$20,000,000 | \$10,000,000 | \$ 4,500,000 | \$34,500,000 |
| 2 | 22,000,000 | 11,000,000 | 4,600,000 | 37,600,000 |
| 3 | 24,000,000 | 12,000,000 | 4,800,000 | 40,800,000 |
| 4 | 26,600,000 | 13,300,000 | 4,900,000 | 44,800,000 |
| 5 | 32,000,000 | 16,000,000 | 5,000,000 | 53,000,000 |
| 6 | 38,400,000 | 19,200,000 | 5,200,000 | 62,800,000 |
| 7 | 46,000,000 | 23,000,000 | 5,400,000* | 74,400,000 |
| 8 | 54,200,000 | 27,100,000 | 5,600,000* | 86,900,000 |
| 9 | 72,000,000 | 36,000,000 | 5,800,000* | 113,800,000 |
| 10 | 93,600,000 | 46,800,000 | 6,000,000* | 146,400,000 |
| Totals | \$428,800,000 | \$214,400,000 | \$51,800,000* | \$695,000,000 |

* Debt repayments starting in year 7 would regenerate \$4,700,000 by year 10.

This suggested outlay would result in a doubling of existing federal R. & D. payments to industry in 7 years and a tripling in 10 years, which seems a rational approach. Evidently, any multiples of these values could be used to increase or decrease the rate of expenditure. These may seem like substantial sums. But the governments are now a 52% partner in Canadian industries. As a partner, it is necessary to sustain the health and vigor of the enterprise, so that the benefits of partnership may continue and increase. In terms of manpower, 1,000 professional persons could be employed on such projects in year 1, increasing to 4,000 in year 10. A greater proportion of the funds, however, would be invested in hardware as the projects mature, reducing the manpower needs with time. Thus the 4,000 figure would not be reached in practise. Under the Small Inventors Act, a minimum of 30 new projects could be started in year 1, increasing to 40 a year in year 10. This may not seem a large number. But very few Polaroid or Xerox schemes, both of which came out of a basement, need be found to justify this whole effort.

12. The Overall Administration

Competition is healthy and necessary. But duplication is wasteful and unnecessary. Already Canada is suffering from a proliferation of research and development agencies, and uncoordinated programs. There are signs the fragmentation is increasing. Canadian resources for research and development are so limited that they should be husbanded with great care. One body now in Canada which already has the resources, staff and expertise to play a leading role in the programs suggested, is the National Research Council. This Brief recommends, therefore, an overall administration plan for the programs suggested herein as follows:-

1. THE NATIONAL OBJECTIVES

- a) For each National Objective started, as for Transportation and Computer Technology, a National Objective Committee should be established, with power to define goals, set

priorities, establish time schedules, fix budgets, and determine the work bits for contract bidding.

- b) The National Objective Committee should be made up of representatives from the National Research Council, the Science Council, the Science Secretariat, other appropriate governmental agencies, the academic area and industry.
- c) At least one-half the Committee members should come from industry.
- d) The industry members should be selected from candidates proposed by industry.
- e) An appropriate Federal agency, such as the National Research Council, should offer to industry, on an open competitive bid basis, the work bits established by the Committee as a contract payable from Federal funds and determine the successful bidder.
- f) This agency should administer the contract and report on the conduct of the work to the National Objective Committee.
- g) In every case, the contractor should be an industrial organization in Canada, which has the right to subcontract to an Industrial or Provincial Research Institute, or to a consultant, or to an academic group or to another industrial group, as it sees fit.

2. THE SMALL INVENTORS ACT

- a) Applicants should solicit financial backing for their schemes from the local branches of appropriate financial institutions.
- b) These institutions should select the schemes to be financed, decide the amount of the loan and its terms of repayment,

bearing in mind the fact that the first \$150,000 is fully guaranteed.

- c) These institutions should then apply to the appropriate Federal agency for a guarantee to cover their loan to the applicant.
- d) This agency should administer the total fund and channel it into the financial institutions as it sees fit, based on the performance of the institution on past loans.

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C O M P E N D I U M

of Canadian Views

on

National Objectives

FOREWORD

The following statements are excerpts only from the original correspondence. In some cases the views of several different members of an organization have been combined.

These opinions were received over the period October 1968 to March 1969 in response to the written and public request from the Engineering Research Committee of the Engineering Institute of Canada as explained on page 15 of the Brief.

An alphabetical index of the opinions quoted appears at the end of the Compendium.

28 March 1969

ACRES LIMITED

We should be considering a new pioneering effort - a latter-day twentieth century railroad, coast to coast. The two bands of steel linking the Atlantic at Newfoundland with the Pacific in Northern B.C. would represent a continuous and consistent thread through a new northern development portion of Canada. Possibly another such endeavour, now, would assist in providing a truly national purpose to carry beyond the year 2000.

Mid Canada is quite distinct from Arctic Canada. It provides the opportunities for creating living conditions, through the application of modern technology, which will be fully acceptable to young, enterprising Canadians. Its resources are immense and reasonably located with respect to growing market, giving an opportunity for some really enterprising engineering to achieve truly economic transportation modes for both primary and manufactured goods.

J. Gavin Warnock
Vice President

AIR CANADA

Certain past hardware developments in our country have been throttled by other countries going on line first with hardware production, resulting in waste of time and money and lost opportunity to Canadian industry. Classic cases of "too little, too late".

In setting national objectives in our Canadian Civil Aviation Spectrum of research and development we must recognize that it is necessary to establish objectives that improve the productivity of the total system, not just the airplane itself.

The three areas in the civilian transport system that we in Air Canada recognize must receive the most searching attention are, in order of priority:

1. Airports and Support Facilities
2. Noise
3. Air Traffic Control

I would stress what is shaping up as the major aeronautical challenge of the 1970's, that is, the low-visibility landing problem. The potential rewards or losses entailed in the investment in airline jets

will hinge in part on the ability to operate them at increasingly lowered visibility and in dense air traffic environments.

Civil Aviation is still using simple glide slope and localizer receivers which cannot provide the foundation for high precision terminal navigation aids and equipment for all-weather zero-zero operation. Very considerable virgin territory exists in Canada for systems Research and Design to international standards of all-weather landing aids.

Footnote: Companies from several industries, such as, the Chemical, Pulp and Paper, Mining, and Aeronautical industries prefer to participate through their industry briefs to government. These briefs are not reported here.

AIR CANADA (Cont'd/...)

It is quite apparent that the increasing overload of the transportation systems in the vicinity of major population centers can only be reduced by a coordinated use of all suitable modes of transport. One of the most promising modes appears to be aircraft with vertical take-off and landing capability. We also believe that a small VTOL type of airplane is a particularly advantageous possibility in Canada and would serve well, areas of difficult terrain and geography. This type of vehicle would replace the smaller reciprocating engine and turbine powered aircraft used in northern or bush type operations. It would comfortably operate into and off totally unprepared ground and certainly reduce the heavy capital and operating investment in airstrips of low utilization. Research and Development necessary to evolve and introduce such an airplane could well be the forerunner of a second generation VTOL which would be a highly successful military and business executive type airplane.

Because of the world-wide potential application of VTOL airplanes and because this potential has so far not been exploited, it is recommended that you add to your listing of National Objectives the development of all aspects of VTOL vehicles, terminals and ancillary equipment.

The final suggested National Objective for the EIC list is that involved with nuclear power. We recommend that Canadian industry, with Government financial support encourage research and development of a nuclear powered propulsion system for use in airplanes.

A nuclear powered aircraft can be built from a technical standpoint in the next ten years and we forecast it will be. The Lockheed C5 military transport for example borders the range where nuclear power becomes practical.

Forecasts of air freight will require civilian versions of cargo aircraft of the C5 size and economics by the early 1970's, and by the later 1970's, even larger aircraft will be economically supportable. By the late 1970's the use of nuclear power in airplanes will be underway and their practicality and economics will be established with very appreciable

increase in safety. This development will make the use of chemical and fossil fuels impossible on airplanes of the size and range of the large cargo transports.

H. W. Seagrim
Executive Vice President

ALCAN RESEARCH AND DEVELOPMENT LIMITED

1. An attack on pollution in all its aspects
2. An in-depth study of climate and weather
3. Oceanography in its broadest sense
4. A medical-sociological attack on mental problems

The objectives in the first instance should be broad and few in number.

J. F. Horwood
President

THE BELL TELEPHONE COMPANY OF CANADA

It is our firm conviction that a successful and viable national science effort is a major prerequisite for realizing the almost unbounded potential of this country in the second century of Canadian nationhood.

As one of the largest companies in Canada, one whose job is service to the public, Bell Canada is engaged, both directly and through our subsidiary the Northern Electric Company, in the largest program of industrial research and development in Canada.

Our gross corporate R. & D. program for 1969, including subsidiaries will be about \$50 million. This effort has been expanding rapidly in recent years and will continue to do so. Of this total amount \$41 million represents our indigenous Canadian effort, and \$9 million covers imported R. & D. information, and patent licences.

We endorse the broad goals for a national science policy which have been set forth by the Science Council in their Report No. 4, towards a National Science Policy for Canada.

It is recommended that the Federal Government's programs for supporting research in industry be reviewed. While the incentive grants for industrial R. & D. should continue, we suggest that better terms should be provided for companies maintaining a high level of R. & D. without a spectacular annual increase in R. & D. expenditures. It is further suggested that research work carried out in the social sciences in support of a company's corporate planning effort should qualify for Federal grants in support of industrial R. & D.

We recommend that Governments, both Federal and Provincial take steps to develop the study of new technological aids in education, in cooperation with industry. This is particularly important at this time as otherwise Canada will not be able to keep up with the rapidly advancing technology in the educational field.

The trend towards micro-miniaturization of electronic circuitry will play a major role in revolutionizing present design techniques. For this reason we recommend that the Federal Government support a major national research and development effort to ensure that Canadian technology in this field is maintained at a high level.

Among the major changes now underway in the telecommunications industry is the development of so-called micro-miniaturized circuits to perform all kinds of electronic functions. Several tens of thousands of passive and active components, including transistors, can be packed into a so-called Large Scale Integrated Circuit, the whole process being controlled by computers. This technique when fully developed, will make it possible to provide great redundancy of circuits thus reducing the possibility of circuit failures to almost nil. Bell Canada sees a great need for intensified R. & D. in the field of micro-miniaturization in Canada and recommends that the Federal Government give support of R. & D. in this field extremely high priority.

R. C. Scrivener
President

THE BOWATER POWER COMPANY LIMITED

Canada, with its vast water resources, has a tremendous heritage and assets. In most other countries of the world, such resources have already been quite hard pressed compared with our own. We should pursue any approach to combatting the pollution problem before it more seriously overtakes us.

The other peculiar problem to our future economy is extending our coast

navigation season with new resources; minerals, oil and others being developed. This is extremely important to our future.

J. H. Beardsley
President and General Manager

BRITISH COLUMBIA TELEPHONE COMPANY

I have a technical training objective which may be of interest to you. We would like to develop a teaching machine for technicians and other skilled craftsmen in our industry.

It would be an audio visual device with a "black box" control in between tape and projector to accept student answers.

S. C. Evans, P.Eng.
Division Engineer - Northern

THE CANADA TRUST COMPANY

Because of the obvious worthwhileness of the undertaking, I would like very much to feel that Canada Trust - Huron & Erie could assist in the formulation of these objectives but, quite frankly, I don't feel we are equipped in any way to do this.

J. A. Taylor
Chairman and President

CANADIAN CANNERS LIMITED

It is our opinion your submission should include recommendations that the Canadian Government carry on its various incentives and grants for research. This would apply to the grants under the Department of Industry (PAIT and IRDIA) and the National Research Council (IRAP). It would be our recommendation that these grants be increased, if possible, but should not be diminished in any way.

L. H. Johnston
President

CANADIAN INDUSTRIES LIMITED

I believe the objectives, which you have set forth in the second paragraph of your letter, have been substantially accepted in the recent statement of the Science Council of Canada made public early this week.

As a corporation we have been working with the Canadian Chemical Producers' Association on this subject. In order to avoid confusion we feel our views should be continued to be expressed through one association.

Leonard Hynes
President

CANADIAN MARCONI COMPANY

This company has for many years been engaged in very advanced development in the electronics field and has been greatly assisted in such work through the federal Departments of Industry and Defence Production. As a result, we have been able to employ a large number of the highest grade engineers and have achieved substantial volumes of business, mainly in the export field. We have also had excellent relations with NRC over many years, and have adapted some of their basic technology to the production of certain designs, notably marine radar.

Accordingly, we are most interested in, and would like to support any procedure that will further the process of Research and Development in Canada. However, we feel that in setting up the proposed ministry, great care should be taken to avoid duplication of services already provided and to ensure that the arrangements are as encouraging to industry as are those presently existing, as referred to above.

L. M. Daley
President

CANADIAN PACIFIC

Transportation appears as a basic theme underlining the fundamental importance which it bears in relation to the particular economic geography and present day development of this Country.

S. M. Gossage
Vice President

CANADIAN SUPERIOR OIL LTD.

We agree with your statement that it is desirable to have industry participate and have an effective voice in national science affairs.

There is an area of investigation into low cost and possible revolutionary methods of transportation which is highly desirable both from a national and economic point of view.

A. E. Feldmeyer
President

CASSIAR ASBESTOS CORPORATION LIMITED

Those projects which cover the widest field in the Canadian scene should receive priority. I would include productivity and transportation in this classification.

J. D. Christian
President

CENTRAL-DEL RIO OILS LIMITED

It seems to us that Canada at this stage of development needs two things - competent, qualified, technical personnel and legislation which would be favorable toward development of its natural resources. We, therefore, respectfully submit the following suggested projects which could be exploited and developed:

1. Transportation to and throughout the north.
2. Construction in the north and the necessary buildings, etc.
3. Good and sufficient weather reporting stations and proper interpretation of the data received.
4. Investigation of the agricultural possibility in the north.
5. Investigation of the use of pipelines for the transmission of solids.
6. Good communications particularly to and throughout the north, possibly with the use of satellites in orbit.
7. Exploration, development and exploitation of undersea possibilities.

J. F. Hardy
President

CHRYSLER CANADA LTD.

What specific national technical objectives for Canada does Chrysler suggest:-

1. We are essentially in the transportation business and it is natural for us to look here first. Canada is somewhat unique in its geography, typography and population disposition. Our people are spread thinly east and west along the U.S. border, whereas the natural North American communications and transport streams are north and south - i.e. west coast, prairies, east coast. All this suggests that Canada would do well to tackle the technical problems of cheap east-west transportation.

Special Committee

CHRYSLER CANADA LTD. (Cont'd/...)

2. Despite the relative youth of our country, we are fast using up or despoiling our water supply. The problem is not unique to Canada, but there is no reason that water utilization, preservation, and reclamation should not have a high priority.
3. In our burgeoning megapolis communities, the affluent society is in danger of being buried under its own garbage. The cost of removal and disposal of refuse in our large cities of apartments and factories is growing to major proportions. In the United States, this cost ranks third in the scale of public services just behind schools and roads. Schools and roads at least do something, but garbage is all outlay with no return. The challenge here is to make it give up a return.
4. Canada's economical well-being is dependent in large measure on agriculture. Agriculture, in turn, depends a great deal on weather. How about research into climate control? Far out maybe but who thought a mere decade ago that there would be men circling the moon.
5. Canada has a serious housing problem. Conventional building methods do not seem to do the job and construction costs are spiralling upwards. Let us change our whole approach to building housing and shelters. Utilize the automotive mass production techniques; Alcan has made a start. Further research and study could well give Canada a commanding lead in this area.

G. A. Lacy
Director - Engineering & Special
Products.

CONSUMERS GLASS COMPANY LIMITED

I suggest that this subject should probably be broken down into two separate areas: First, those areas of science and technology which relate to social aspects of life in Canada, and I refer here primarily to things such as housing, urban planning, water resources, pollution and waste disposal, all of which I believe urgently require the best talent the country can provide. Perhaps under the same heading I might include the whole subject of northern development, an area which can probably keep the scientific and technological brains of the country occupied in perpetuity.

From a pure science and technology side, the more practical applications of a direct benefit to industry primarily are almost endless. It seems to me that primary emphasis should be placed on the development and processing of our fast diminishing natural resources such as uranium, petroleum and a long list of metals.

J. D. Mingay
President

CYANAMID OF CANADA LIMITED

We feel that the order of priorities should be:

- . transportation methods, systems, and techniques
- . anti-pollution measures to enhance value of one of our most important assets; i.e. water
- . program to optimize the upgrading of energy
- . standardization of construction materials and methods
- . high degree of flexibility in secondary industry
- . development of large scale inter-related chemical complexes
- . measures to stimulate more efficient service industries
- . communications
- . increasing agricultural productivity
- . by-product utilization of mining and metallurgical operations
- . increased use of forest waste

B. H. Loper
President

DCF SYSTEMS LIMITED

We have recently thought of a project that could provide the extensive socio-economic benefits that you seek.

This project would entail establishing a communication network and a computer-based information system, on a nation-wide basis, to collect and match personnel requirements of Canadian organizations to the people seeking employment. Only recently have the equipment and techniques been developed to the stage where such a system would be both economically and technically feasible.

I believe that such a system would increase national productivity, by reducing the average length of time that employable people remain unemployed. The system can provide more efficient allocation of available resources. It can thus reduce the amount of financial support the government needs to offer to economically depressed areas.

Harvey S. Gellman, Ph.D.
President

THE DE HAVILLAND AIRCRAFT OF CANADA, LIMITED

We are certainly aware of the importance of the development of National Objectives for Science & Technology, and we are most anxious that we make a contribution in the development of these objectives.

We are working directly with our industry association, the Air Industries Association of Canada, in preparing a brief on this subject, and to avoid a great deal of duplication, I think any in-puts from the companies in the aircraft industry should come from the headquarters of our association.

W. B. Boggs
President

DOMINION BRONZE LIMITED

Our Company has a similar interest in solving some of the technological problems of our time, and to this end we are engaged in a program of sponsored innovation of interest to entrepreneurial-minded engineers in Canada.

This program aims at encouraging profitable innovation and new product ideas, and includes the sponsoring of specific innovation missions with qualified inventors.

Boyd S. Moore
Manager, New Product Research

DOMINION STORES LIMITED

One suggestion that I would have is that if the government does decide to spend money on this area that part of it be put aside for socio-economic research - to better understand the Canadian consumer and research into improving food distribution methods.

Since more and more of the gross national product is being devoted to building up the wealth of the non-productive elements, i.e. the distributive segment of the economy, I feel that at some point this has

to be recognized. There are tremendous wastes existing across the country in the area of food distribution and nothing really significant is being done at the federal government level.

J. Nestor
Manager of Research

DOW CHEMICAL OF CANADA, LIMITED

1. World Wheat - The basic concept is chemical removal of the cellulose and bran from the wheat kernel. This leaves a material that is rice-like. At the present time there does not seem to be any significant advantage in the milling of wheat to flour. A significant advantage to Canada would be the preparation of our wheat into a form that is acceptable to the oriental as far as his diet is concerned.

DOW CHEMICAL OF CANADA, LIMITED (Cont'd/...)

2. Extension of the St. Lawrence Seaway Operation -
To maintain the Seaway in an operating condition throughout the winter or at least a major extension of the operating season. An obvious thought is the use of atomic energy in sufficient quantity to maintain temperatures in selected areas such as locks above the freezing point. Spent fuel elements from atomic reactors might be a sufficient source of heat. Such technology raises the question of thermal pollution resulting in fish kill. Technology as used in Scandinavia should have first consideration whereby channels are kept open by air agitation. It is possible that an insulation material could be floated on the locks in such a way that it would not impede the entry of a boat and yet could be recovered by a skimming technique and returned to the upper locks for re-use. Foamed polystyrene beads might be considered for this latter experiment.
3. Pulp Mill Wastes -
4. Materials Science -
5. Soil Stabilization -
6. Energy Costs Reduction - This is at present a point of very considerable concern to the chemical industry which is a large consumer of energy both heat and electrical. The Canadian industry finds itself at a considerable disadvantage in this regard when compared to the U.S.
7. People - This heading does not fall into the natural sciences but does affect their success. Productivity of individuals is substantially less than it could be. Output could be raised by the application of more automation and the utilization of greater amounts of energy. The principal problem however appears to be attitude and lack of any sense of participation in group effort.
8. Improvement in Forest Yield - Forest Fire Control - Extension of the Active Growing Season of the Canadian Forest
9. Black Fly Control -
10. Pollution Control - Waste Disposal - Hospital Waste Disposal
11. Analyzers - There is a strong need in the process industries for on-line analyzers of substantially improved reliability. At the present time the lack of reliability and of suitable analyzers inhibit the application of computer control of processes.
12. Interfaces between Technologies -
13. Transportation -
14. Adoption of the Metric System -
15. Plant Construction Techniques -

J. L. Smart
Vice President

FALCONBRIDGE NICKEL MINES LIMITED

As long as the decision power rests with either civil servants or political appointees, you will not have a truly progressive research effort in this country.

H. J. Fraser
President

HOME OIL COMPANY LIMITED

The actual objectives should be set on as broad a basis as possible such as transportation, northern development, conservation, etc., and that these be approached on a "systems" basis.

A good example of such a "systems" approach is the program set up for the investigation of transportation of solid materials in slug or container form by pipelines.

Specific areas of interest to our industry are:

- a) Reduction of the transportation burden on raw and finished materials with specific emphasis on the supply of indigenous crude oil to all Canada thus avoiding dependence of Quebec and the Atlantic provinces on off-shore crude.
- b) Increase Canadian content of exports through up-grading exportable raw materials to finished or semi-finished products - this is true for all resource based operations.
- c) Up-grading of waste products, often pollutants, to saleable products - this has limited application in most areas of the petroleum industry.
- d) Northern development with special emphasis on road building and maintenance, general transportation, including pipelines, and environmental conditioning such as domed cities.

I. M. Drum, P.Eng.
Vice President - Special Products

HUDSON'S BAY OIL AND GAS COMPANY LIMITED

Communication

A satellite to make more channels available to all of the country and to extend telephone service to areas beyond reach of land lines and microwave.

Transportation

Solids pipelines for economic long distance movement of bulk materials. Liquefied natural gas pipelines. Rapid transit systems. Systems and devices particularly applicable to northern areas.

HUDSON'S BAY OIL AND GAS COMPANY LIMITED (Cont'd/...)

Pollution Control

Development of code of standards adapted to various locales considering: Population density; Pollution source density; Land use classification. Processes for recovery or disposal of pollutants.

Housing and Schools

Flexible building code standards to encourage use of economical materials, prefabrication, add-on building plans, and lot servicing economies. Development of low cost materials and assembly procedures.

Petroleum Industry Research

Petroleum will play an important part in supplying the future energy requirements of North America. Research aimed at improvement in industry effectiveness should ultimately contribute to our standard of living.

Exploration

Geological data retrieval and organization
Computer applications in geophysics.

Drilling

Methods other than conventional rotary - Drilling fluids -
Cementing methods and materials - Well completion
techniques - Rig automation - Offshore operations

Formation Evaluation

Well log digitizing and interpretation - Pulse testing -
Formation (drill stem) testing and interpretation -
Factors affecting relative permeability.

Enhanced Recovery Processes

Well Productivity Stimulation

Lease and Plant Automation

Gas Treating Processes

D. C. Jones
Executive Vice President

IMPERIAL OIL LIMITED

Major emphasis should be placed upon:

1. Capitalizing on particular Canadian advantages;
2. Minimizing the impact of unavoidable inherent disadvantages.

IMPERIAL OIL LIMITED (Cont'd/...)

A non-exclusive listing of Canadian economic advantages, real or potential, would certainly give a prominent position to such natural resources as:

1. Mineral and fossil fuels
2. Water resources
3. Agricultural and forest resources

On the side of disadvantages from an economic standpoint, Canada is "blessed" ("stuck") with great distances and extremes of climate. These factors justify national technical objectives emphasizing research and development in:

1. Transportation and communications equipment and systems, (land, air, water).
2. Forecasting (meteorology) and efficient adaptation to weather conditions (e.g. specialized or novel transportation, housing, heating, weather control and so forth.)

W. O. Twaits
President

IMPERIAL TOBACCO COMPANY OF CANADA LIMITED

Communications

Transmission of information and transportation of people, raw materials and finished goods. For example: improved means of moving people between suburban and downtown areas; between major urban areas; new approaches to trans-Canada travel to increase national solidarity. Other thoughts are ways of keeping the St. Lawrence Seaway open all year and to develop economically acceptable means of transport for the oil and other natural resources likely to be found in the far north.

Development of Natural Resources

Both land and water, with greatly increased efforts to convert in Canada the products of natural resources to manufactured goods for domestic and export use.

Food Technology

Develop synthetic foods, improved methods of food preservation and better utilization of food stuffs.

Housing and Urban Problems

Includes studies of the effect of severe congestion on the population, the establishment of new urban centers and cheaper methods of housing construction.

Environmental Pollution

Pollution of air, water and land is rapidly becoming a most serious problem and steps should be taken immediately to conquer these problems which, if unsolved, could ultimately result in self-extinction.

IMPERIAL TOBACCO COMPANY OF CANADA, LIMITED (Cont'd/...)

Climate

On the one hand pursue programs to make man increasingly independent of climate, while on the other hand, develop ways and means of modifying climate to increase water table levels, agricultural productivity and utilization of northern areas.

L. C. Laporte
Vice President - Research &
Development

INDUSTRIAL WIRE & CABLE CO. LIMITED

We have to export to Europe products requiring high voltage testing and send to the States problems relating to circuit interruption above normal amperages. Rationalize this if you will in a country whose power generation capability and transmission and distribution networks are amongst the most advanced in the world.

G. D. Zimmerman
President

LAKE ONTARIO STEEL COMPANY LIMITED

I believe we could make further significant contributions in those areas in which we stand to gain a major economic advantage, such as:

1. Northern transportation with investigations into pipelining, Hovercraft, a large transport aircraft, tracked vehicles, new railway techniques, and any other transportation systems which will help us move our mineral, timber, and fuel resources to markets.
2. Along much the same line, we should direct our thinking toward on site processing techniques for the mineral industries, and the development of low cost package power plants which would be necessary for economic on site processing.
3. In the social sciences, we should be directing a good deal of effort to the problems of living in the North; not only the physical and environmental problems, but also the social problems that develop through isolation.

G. R. Heffernan
President

JOHN LABATT LIMITED

We feel that logic leads to only one conclusion in this matter:

1. Effectively, at present, Canada comprises a strip 100 miles wide and 3,000 miles long **adjacent to the** United States border.

JOHN LABATT LIMITED (Cont'd/...)

2. Scientific needs applicable to this strip are being developed in the United States in a far better way than anything that Canada can afford.
3. Unless we apply the appropriate vision and imagination within the next twenty or thirty years, this strip must become to all intents and purposes a part of our large neighbor to the south.
4. To avoid this, we must maximize the potential advantages of our major difference from the United States, namely, Canada's Northern and Arctic Regions.
5. We suggest that our National Objective for Science and Technology be "Development of Canada's Northern and Arctic Regions".
6. Based on this theme:
 - a) Transportation, the goal would not be a modification of existing equipment, but the development of equipment suitable for the combination of muskeg, snow, ice and northern desert.
 - b) Urban development, the goal becomes the special design of dwellings, connecting links (not necessarily roads), waste disposal, etc. for areas in which the wind chill (not the temperature) may be -80°F . and the summer temperature may be 100°F .
 - c) Agriculture takes on a new look in developing the muskox, reindeer, caribou, Arctic char and the like, as sources of protein from the animal kingdom and in improving the local supply of nutrients from the vegetable kingdom (grains, greens, roots, forage crops).
 - d) Water conservation and water resource management will be redefined to meet the needs of areas where the water may be frozen for nine to twelve months of the year.
 - e) Secondary industry must move into the area to refine ores to fabricate metals, to process petroleum, and to build equipment under different climate conditions.
 - f) Recreation and the use of leisure time under northern and Arctic conditions will also have to have new and different goals.

J. A. Pearce, Ph.D.
 Technical Assistant to the
 Vice President - Planning

MACLEAN-HUNTER LIMITED

Today's information needs are becoming greater and increasingly sophisticated. They can no longer be satisfied by means of the printing press and conventional broadcasting alone. It is recommended, therefore, that the following be placed high on a list of national technological objectives:

MACLEAN-HUNTER LIMITED (Cont'd/...)

1. Analysis of various forms of information needs relevant to Canadians.
2. Examination of the means of satisfying each of those needs, and of the role of the private information industry in this.
3. Developing the technologies involved, especially where they are relevant to particular Canadian national requirements.
4. Continued development of electrical power transmission techniques capable of transferring large blocks of power over long distances. This would take advantage of Canada's unique position of having high energy demands and vast areas to service.

While Canada has been among the leaders in Extra High Voltage transmission, we are in danger of becoming also-rans in the most promising area for the future - High Voltage Direct Current transmission. Technology for the first Canadian applications of HVDC has been virtually all imported.

George W. Gilmour
Vice-President, Business
Publications Division

MACMILLAN BLOEDEL LIMITED

We welcome the opportunity to be heard on this matter and completely endorse your statement that "the quantity, nature and quality of R. & D. carried out in Canada are vital factors in our national well-being".

The export of products created by scientific know-how in secondary, science-based industry provides the best new opportunity for correcting Canada's trade imbalance and for improving our competitive position in the world markets. Federal research and assistance policies must be framed around this concept.

We recommend that:

1. Federal intramural research be directed towards national socio-economic technical needs rather than be directed towards industrial technical needs. This is basic research and would lie in such fields as
 - energy (atomic and fossil fuel)
 - water use and distribution including desalination
 - water, air, noise and other environmental pollution improvement
 - oceanography or marine technology
 - developing new food sources (agricultural research).
2. The Federal Government should identify, implement and vigorously pursue specific national science goals in order to establish a suitably innovative climate in Canada for Canadian science and industry. A typical national science goal is the current high-energy nuclear research and development program.

MACMILLAN BLOEDEL LIMITED (Cont'd/...)

It is worth noting that the Space Program in the United States provides ample evidence that national goals, contracted research, and unlimited marketing of new products have been stimulating to American industry and, in fact, trigger chain reactions of an innovative nature which help further to establish and develop secondary industry.

3. A larger proportion of Federal research and development work be contracted out to Canadian industrial companies as a further aid to establishing a beneficially innovative spirit in industry.
4. Manufacturing not be limited to Canada only nor marketing to the Canadian market of new products and processes that may be developed with Government assistance or under Government industrial research contracts.
5. The National Research Council fulfil its declared objective of assisting industry by administering a national computerized information gathering, translating and disseminating service.
6. Overhaul and review the whole spectrum of Federal Industrial assistance programs such as IRDIA, PAIT and NRC grants to place greater emphasis on the high cost part of the "innovative chain", namely the advanced development and commercial exploitation of a successful idea or discovery.
7. Introduce tax measures (e.g. holidays) that will supplement the assistance programs and that will in themselves act as incentives for industry to undertake the complete innovative chain of events leading to the marketplace.

E. N. Walton
Chief Engineer

MAPLE LEAF MILLS LIMITED

There is plenty of research that could still be done to determine what crops should be grown in different parts of the country and on what soils, and what should be done to these soils to get the best results.

Further development of crops to ease the dependency of the Western farm economy on wheat. This could range from new grains to new wheat varieties which would provide an alternative to corn for starch manufacture. It could also involve new oilseed crops with fatty acid compositions tailored to nutritional and industrial needs.

Continued studies on the nutrition of humans with vegetable protein. There is some doubt that we will ultimately be able to obtain enough protein from meat even in the highly developed countries. In addition, the production of meat protein is very inefficient. We can obtain much more protein from the same land if we use vegetable protein. This involves more technology than nutrition. The trick is to put the protein into an acceptable form.

One of the more pressing problems facing Canada is that of water resource control and this area must be considered as a high priority. Another area is control of land use, which in Canada seems extremely haphazard.

G. M. MacLachlan
President

MINNESOTA MINING AND MANUFACTURING OF CANADA LIMITED

From the viewpoint of a subsidiary of a foreign company, one of the deficiencies we think could be overcome would be to treat such industries on the same basis as Canadian owned industries insofar as research subsidies are concerned.

It would be easier to organize and operate new research and development groups within such subsidiary companies if initial subsidies were provided with no strings attached concerning the use of the results of their programs.

Rather than handicap foreign subsidiaries, Canada should help them become more effective because the tendency will be to concentrate research in the home area where it usually is already established.

Roy W. Keeley
Executive Vice President
and General Manager

MOLSON INDUSTRIES LIMITED

I believe that the national objectives should include the following

1. A higher percentage of Canadian research and design should be carried out by Canadian industry.
2. Combining all government research and development groups into one, for the sole purpose of developing Canadian industry.
3. Cancellation of all government research and plans, such as, GIRD, PAIT, etc., and replace with tax incentives and/or low interest loans.
4. All necessary research capability should be directed to helping meet the group goals of Canada's Economic Council.

I think the idea of having an approved method of handling Science and Technology, even to the point of having a Federal Ministry, could much improve the situation in Canada.

I think it would be well to have Industry represented in major research ventures, not for the purpose necessarily of forming the advanced research practice but rather to participate in the measuring of benefits that might evolve from a particular project and more importantly to assist in development of a business-like approach to a program of Science and Technology.

D. G. Willmot
President and Chief Executive
Officer

NORANDA MINES LIMITED

Noranda has taken a position with respect to research through the Canadian Mining Association and also through the C.M.A. Our interest extends to the mining and metallurgical industry and also into associated secondary industry.

Our effort has primarily been directed at stronger government support of research to be carried by industry and we feel that there is still much that should be done in this area. Our proposals regarding steps which the government might take are on record.

J. N. Anderson
Director of Metallurgical
Operations

NORTHERN ELECTRIC COMPANY LIMITED

We do believe in the two vital criteria which you have given in your letter of October 18, and we do not believe these criteria have been sufficiently applied in the past.

Communications is one area which has not received much attention. We believe this is every bit as important as transportation and government, universities and industries should be encouraged to carry out a well integrated program of research and development in the field of all known types of communication media.

J. C. R. Punchard
Asst. Vice-President

PHILLIPS CABLES LIMITED

We feel that Canadian technical effort should be directed towards specifically Canadian problems and opportunities, such as:

1. Distance

- a) Transport systems suitable for long distance and relatively light traffic, for long distance transport at low cost, including energy transport, or for transport of people and goods over undeveloped country, including frozen ground or water.
- b) Communication systems suitable for long distances in sparsely populated country, including low capacity systems for the undeveloped parts of the country but also providing for the high-quality and sophisticated services required in settled but low-population-density areas.

2. Land Use

- a) The development of crops suitable for those parts of Canada where there is now little or no agricultural development.
- b) The upgrading, or other conversion to a useful condition, of muskeg.

PHILLIPS CABLES LIMITED (Cont'd/...)

- c) The development of methods of construction, heating, local transport and amenities to make life in remote communities in a cold climate more attractive.
- d) The study of life in cities as a system and the development of improved means of transport, supply, waste disposal, etc.

3. Resources

- a) Means of converting Canadian materials into finished products or more advanced semi-fabricated products than those in which they are now sold.
- b) Methods of food preservation, processing and up-grading.
- c) Mining and extractive metallurgy.
- d) Means of developing resources with minimum degradation of the environment.

4. Products

- a) The reinforcement of products and industries in which there is a record of Canadian success, such as aircraft, chemicals, electrical products, agricultural machinery, and nuclear energy.
- b) The fostering of a domestic computer industry, both hardware and software.
- c) The fostering of other, high-growth-rate industries likely to be important in the future.
- d) The fostering of industries for which Canadian products should have, and in the export market would be recognized as having, special merit, such as water and winter sports gear, space heating equipment, long-haul energy transport and communication systems, and others.

5. Skills

The improvement of processes and industrial management techniques suited to Canadian conditions, which often require flexible manufacturing processes capable of the economical production of limited runs. There is some reason to think that Canadian manufacturing suffers from the fact that many of the available methods and types of equipment were developed for use in different and larger markets.

J. S. Waddington
Vice President

POLYMER CORPORATION LIMITED

In the realm of national science policy it is my belief that a more pressing subject than national objectives is a realistic analysis of how to encourage total and profitable innovation in the private sector.

E. R. Rowzee
President & Managing Director

THE ROYAL TRUST COMPANY

We do suggest that anti-pollution projects, which are undoubtedly already included, be given a priority ranking.

Allan M. Edson
Executive Assistant to the President

SHERRITT GORDON MINES LIMITED

We are in complete agreement with statement (b) in your document "A Canadian Policy for Research and Development" namely, "The research and development work needed to achieve each national objective is carried out essentially by Canadian industry, under governmental financing".

We feel that as high priorities the following should be considered:

1. Improvements in transportation
2. Scientific aid to develop more efficient systems for mineral exploration
3. Improvements in technology - of mining and processing of ores to finished metals (including automation and computer use)
4. Encouragement of manufacturing industries in Canada (especially those that make use of our national resources)
5. Management of water resources.

In general we prefer the creation by Government of a favourable economic climate in Canada that would permit various industries to accomplish these goals with a minimum of direct Government involvement.

David D. Thomas
President

THE STEEL COMPANY OF CANADA, LIMITED

The more practical and acceptable method of enhancing scientific achievement and accelerating advance in applied research would be through a program of tax incentives, rebates or fast write-offs. Thus, the benefits of free enterprise and the profit motives could be applied to meet the demands for technological advance and the expansion of scientific innovation.

Where small companies or industries do not possess the personnel, resources or facilities to embark on research programs or scientific development within their own sphere, the government could encourage collaboration or provide specific assistance or incentives.

Any proposed move toward direct governmental involvement, co-ordination and control of industry's destiny in technological advance and the expansion of scientific knowledge moves industry one step closer to nationalization and complete governmental control. Let us take the initiative ourselves and not wait for the government to guide our technical destiny.

H. M. Griffith
President

THE TORONTO-DOMINION BANK

It would be unwise to suggest any short-term objectives for science and technology in this country if by the short-term we are referring to projects which could involve increased expenditures over the next two or three years. There is no doubt in my mind that science, technology, research and development are all very vital to Canada's long-term economic development. I believe, therefore, that we should be doing a great deal more in this country than we are presently doing. Finally, I believe that we should be paying a good deal more attention to those projects which will yield us the highest returns in terms of costs and benefits in a highly competitive technological world.

With the above views in mind, I suggest that this is a proper time to assist the Government with the screening of projects so that those which appear to be more important are given priority in the estimates while those which are of doubtful or marginal worth to Canada should be dropped. I think, therefore, that our short-term objectives must be confined to the careful screening of specific projects whereas the longer-term

objective should be looked at in terms of the direction in which Canada should tend to specialize internationally.

Allen T. Lambert
Chairman and President

TORONTO STAR LIMITED

I am in agreement that objectives are important and are necessary. Such objectives should be in keeping with our capital capability and should be based upon exploiting the unique aspects of Canada's wealth. One of the objectives which is of primary importance to Canada would be the development of our natural resources.

Burnett M. Thall
Vice President

TRANS MOUNTAIN OIL PIPE LINE COMPANY

Two worthwhile national technical objectives for Canada would be:

1. Expansion of existing work being done on the transportation of solids in pipe lines.
2. Investigation of means of environmental control in large areas for population comfort and agricultural purposes.

A. W. Samson, P.Eng.
Chief Engineer

UNITED AIRCRAFT OF CANADA LIMITED

Generally we agree with the current theme that more of the country's research and development should be done in industry and with the further view that this R&D should be product oriented so as to have an evident economic benefit to Canada. Projects where the main output is technical

UNITED AIRCRAFT OF CANADA LIMITED (Cont'd/...)

fall out only or increased national prestige should, in our view, be sharply restricted.

As to detailed product objectives for the aerospace industry, we believe that one Canadian objective should be to design, develop, produce and sell at home and abroad, utility airplanes and small powerplants. There is established competence and demonstrated world-wide marketing ability in these areas now. This objective is in line with the idea of cultivating excellence and is consistent with choosing projects which are compatible with our national financial capability. These products are also ones which contribute to improved transportation in the Canadian north as well as in the rapidly developing airplane commuter services which are bringing air transportation to the smaller communities.

E. L. Smith
Vice-President - Engineering

P. ACKERMAN, P.Eng.

The shift from our limited, frail human labor to the use of limitless, harnessed nature's forces as new producing forces in the Industrial Economy, enables us to produce not only any amount of material wealth, but we can do it with ever less human, man-hour labor requirements. Here, then, is the question: how is the Industrial Society going to absorb healthily and permanently the resulting superfluous labor?

A National Retirement Plan would retire enough active income-earners to make room for the unemployed and the yearly new crop of school-leaving youngsters seeking employment. The Pension would be equal to the high or low income-earner's attained income. By shifting the unemployed into the upper age brackets, the unemployment situation would be eased at once.

QUEEN'S UNIVERSITY - FACULTY OF APPLIED SCIENCE

The Engineering Institute's apparent insistence that the research and development work needed to achieve each national objective be carried out essentially by Canadian Industry is a cause of concern. Unless Canadian industry in general is prepared to develop a considerably greater awareness of what is necessary and how it should be achieved than is the case at present, the Institute's criterion (b) appears unrealistic. We would hope that Canadian industry would see fit to sub-contract some of the research to properly organized University research institutes, centres or Engineering Departments.

With respect to specific national objectives, the following projects, not in order of priority are suggested: The development of --

QUEEN'S UNIVERSITY - FACULTY OF APPLIED SCIENCE (Cont'd/...)

- a) Efficient Communication Systems
- b) Satellite Communications
- c) Computer Systems
- d) Efficient long distance and short haul transportation systems.
- e) Engineering technology for cold conditions
- f) Bio-Engineering techniques in conjunction with the medical profession.
- g) Interconnected Power Systems
- h) Manufacturing Process Technology
- i) Nuclear Fuel Processing Techniques
- j) Nuclear Reactors with higher specific PowerOutput
- k) Improved extractive metallurgical Processes for Canada's less-common metallurgical resources.
- l) Direct Steelmaking - a continuous process from ore to the finished steel product
- m) Similar Direct Processes for non-ferrous metals of interest to the Canadian economy
- n) The Pulp & Paper Industry within Canada
- o) Food Processing and Food Storage Techniques
- p) The use of Polymers as Building Materials
- q) Ocean Resources
- r) More interest in and support for the following areas as a means of improving the competitiveness of Canadian basic industries:
 - (1) Mathematical Modelling
 - (2) Process Optimization
 - (3) Process Control Areas

J. H. Brown
Dean, Faculty of Applied Science

WALTER F. BROWN, M.E.I.C.

Governments in Canada should provide an improved climate for technological research and development in industry by:

1. Improving opportunity for profit by:
 - a) Supporting and improving the patent system
 - b) Continuing to improve the dissemination of technological research information of governmental laboratories to industry.
 - c) Promoting closer liaison between University and industry technological research workers in order that pure and applied research in the universities may bear fruit in the form of marketability of new products, equipment and structures.
 - d) Encourage industry to produce imaginative, esthetic, as well as functional design of products, equipment and structures for the socio-economic well being of the citizens of Canada.

McMASTER UNIVERSITY - FACULTY OF ENGINEERING

The one technological research program which towers over all of the others in Canada in priority is the problem of pursuing a serious research project on the national transportation. Canada's transportation problems are quite unique both in respect to the climatology of the country and, in fact, the nature of its industrial development.

I therefore think that a massive attack on the transportation problems of Canada should be mounted and it should be mounted by a single agency whose first task will be to assemble a comprehensive systems analysis of all of the flows across the width of this country. I think this is particularly important at this time because too many agencies are becoming involved with transportation, each of which will be doing a rather encapsulated project which matches its rather narrow interest.

J. W. Hodgins
Dean

BERT VAN LEEUWEN, A.C.I.D.

1. Modular habitations of all kinds for northern use.
2. Investigate how useful snow would be as a mold for foam structures.
3. Portable powerplants of all kinds.
4. More training of entrepreneurs and designers and other types of "Generalists".
5. The immediate promotion of national education via satellite, computer and programmed learning.
6. The promotion of the university type of education in the same fashion and with correspondence courses so that less money will have to be spent on real estate and more on communication.
7. Development of an all Canadian, all climate, corrosion proof utility vehicle or vehicle modules, allowing interchangeability of components or modules; with independent heat source, engine accessible from inside, capable of travelling difficult terrain.
8. Development of low cost "instant" type of highway surfaces, especially for bogs and cold climates.
9. Lightweight modular overpass systems, suitable for crossing smaller streams and other obstacles.
10. Self-contained lightweight energy systems running on local unrefined gas and oil.
11. Submersible container suitable for towing through waterways and railway transport, with associated systems.
12. Promote and develop a large scale system for "popping" wood particles or flour and develop it into a lower cost substitute for foam structural core material.

RONALD F. MANN, Ph.D., P.Eng.

In the years ahead Canada must lead the way in opening up the Canadian north. Before the wealth and potential of the north can be exploited a great increase in northern population must be achieved. In a very real way the north is our last frontier and migration northward must precede development just as migration westward led to the great developments in the western provinces.

Major improvements in living conditions and comfort could be brought about by so-called "controlled-environment" or "domed cities"; living and recreation areas could be enclosed and interconnected; working areas could be enclosed. Cold, snow and blackflies could be a thing of the past.

CEDRIC MARSH - CONSULTING ENGINEER

The list of National Objectives, recommended in the policy document of the E.I.C. on Research and Development for Canada, might include the ideal low cost transportable residential building.

Canada provides the ideal conditions for such a development, having the extremes of climate and the great distances to be covered, coupled with the demand supplied by the continuing exploring and exploitation in remote areas.

Many schemes have been proposed and implemented. None appears to have established itself as the best answer. All the problems are known and some solutions are known, but a truly satisfactory system is yet to be developed.

Should an ideal system be found for this application, it can be expected to find a place in low cost housing closer to industrial centres, and in the export markets where the demand to be met is not necessarily that of native housing but includes the more sophisticated dwellings demanded by tourists and management personnel in developing areas.

J. G. MELVIN, P.Eng.

Communications, which includes transportation, is such an obvious need for Canada - geographically and politically - that no comment is necessary. We can afford nothing less than the best possible.

Climate Each winter, to our unending surprise, it gets cold and it snows. Our buildings, vehicles, clothes, communications, etc., are seldom of indigenous design and they fail - often miserably - to cope with our climate.

Cities The huge metropolis is a monument to our failure to develop and apply communications and transportation technology. The city is the source of more problems than it solves for society. We have had fair warning from events in the U.S.A. and elsewhere. The goal is simple: eliminate both the need for and the desirability of the large city.

Just these three: Communications, Climate, Cities. I can think of no better, more challenging, or more useful framework for the purpose at hand.

McMASTER UNIVERSITY - DEPARTMENT OF PHYSICS

I would like to suggest that serious consideration be given to the establishment of a nuclear-powered Canadian merchant fleet as a possible objective of the nation's technology. Such an objective could certainly be carried out to a large extent by Canadian industry in conjunction with A.E.C.L. much in the way that nuclear power-station development has been done.

The advantage of the successful completion of such a program is rather self-evident:

1. Such a fleet would be highly competitive, because of the unique features of nuclear-powered vessels. These include minimal fueling times and costs, the feasibility of either higher speed or higher cargo capacity or both; up to some 25% gain in these parameters is apparently possible over conventional ships.
2. Such a program would represent a meaningful Canadian investment to save the ship-building industry, the result of which might save up to some 500 million dollars a year presently paid by Canadian industry to ship Canadian goods in the holds of foreign ships.
3. The program could give a new sense of purpose to the Chalk River atomic energy establishment and would draw heavily upon their expertise. Indeed, a new emphasis on the research and development of ^{235}U technology as well as boiling water and liquid metal enriched-fuel reactors, would be required.

W. V. Prestwich
Assistant Professor in Physics

E.I.C. ROAD SAFETY RESEARCH COMMITTEE

May I give you "Road Safety" in all its phases as the number one project for consideration by the E.I.C. Engineering Research Committee.

The most important single technical objective needing attention quickly is the design and production of roads and highways. Outside of the

human factor (the driver), roads are the biggest contributor to accidents. So it is with roads we must deal. The design, the cost, for cost is always a factor and in many cases a stumbling block, must be researched thoroughly to give us the best type of road for the area at the best price.

There are five major highways leading into Ottawa and all are two-lane highways. One is part of the Trans-Canada highway. This area alone has some 3,000 accidents and 900 injuries, fatal and non-fatal, a year and the numbers are increasing steadily.

J. Weir
Coordinating Secretary

UNIVERSITY OF TORONTO - DEPARTMENT OF INDUSTRIAL
ENGINEERING

I support your recommendations wholeheartedly. Canada's potential in computer technology (especially at the man-computer interface) is tremendous.

There should be a study of possible computer applications in areas of particular importance to Canada, such as transportation, pollution control, and health and welfare. Computer networks need special study. The possibility of a government institute for a continuing and extensive study of all these problems should be given serious consideration.

The economic and cultural strength of a nation largely depends on its ability to take advantage of new developments in science and technology. Unless these opportunities are firmly and promptly grasped the productivity and creativity of its people will deteriorate. Ultimately the survival of the nation will be threatened.

In virtually all research fields the most significant technological development in many years is the computer, supplemented by information networks, large data storage and retrieval systems, and adequate means of communicating with them (i.e. the software and peripheral input and output systems). Despite its comparative infancy, the computer is already influencing more scientific and scholarly disciplines than any other research instrument or technique developed in recent times.

A. Porter
Department of Industrial Engineering

UNIVERSITY OF SASKATCHEWAN - DEPARTMENT OF ENGINEERING

My own view is that the future development of Canada lies, not only with transportation, but by an effective approach to the design of cities and other environments suitable for occupancy during the Canadian winter (and in Ontario even during the Canadian summer!).

It might be possible for Canada to generate indigenous computer industry in a period of five years. This five year period of development would include three years of intensive fundamental research directed at producing radically new ideas in the field of hardware and, as you will see later on, in the field of software; educating the people to work in the field, and doing the basic planning for the industry. I would suggest that the best way to achieve this objective would be to create a centre of excellence with adequate financial support in the hardware field.

Assuming that, until feasibility has been demonstrated, the effort will be conducted entirely within the research group, I would think that the support involved over the initial period would be only a nominal one, say about one million dollars per year for the first two years. At the end of this incubation period, ideas would be available which would require prototype development. For this reason industrial facilities should be set up during the third year, and prototype development carried out. I think that this would call for a stepping up of the budget to about five million dollars in year three.

UNIVERSITY OF SASKATCHEWAN - DEPARTMENT OF ENGINEERING (Cont'd/...)

The only further remark that I would make is that in my view we should produce small computing systems dedicated to specific purposes, and on data handling devices to go with these machines. For particular areas of interest, small dedicated machines are relatively unexploited, and provide a non-competitive market. Examples lie in the fields of computer communication, both between machines and between people, the use of computers in the merchandising industries, where I have felt for many years that human clerical labour should be completely abolished and a credit card system of operation instituted, and in the biomedical communication fields, where there is a vast potential for communication between patients, machines, hospital systems, schools, colleges and so on.

The great bottleneck in the computer industry at the present time is to provide operating systems for the big machines, and special operating systems tailored to customer needs. The mark-up on software is really enormous.

Andrew D. Booth
Dean of Engineering

CANADIAN INDUSTRIES LIMITED

One of the first priorities of the federal government (and of many provincial governments and of Canadians generally) is national unity. One of the difficulties in the way of national unity is the set of language problems arising from the diverse backgrounds of native and immigrant Canadians. It is, of course, particularly acute in the case of French- and English-speaking Canadians which leads to difficulties in the way of creating a bilingual society.

It seems to me that there could be a technological solution to this social and political problem. I have in mind the development of an instantaneous, voice-operated translation machine, that is to say, a "black box" which hears English and speaks in French virtually instantaneously and vice-versa.

The potential rewards are equally great, namely, a great aid to a bilingual society in Canada, creation of a product which could be extended to other languages for sale in virtually every other country abroad both for private use as well as in conjunction with international telephone, radio and television operations, a great step along the road to voice communication with computers and, finally, a great contribution to our general ability in the field of modern information processing techniques together with prospects for all sorts of unexpected fall-out in electronic hardware and software. A joint federal-provincial research effort in this field, in collaboration with industry because of the eventual commercial prospects, ought to be very worth while.

S. S. Grimley
Vice President

THE BOBTEx CORPORATION LIMITED

Your appeal for recommendations with respect to National Goals of the E.I.C. has come to my attention. I feel that the two objectives outlined could well be adopted by the E.I.C. in its program as they meet the fundamental criteria incorporated in the E.I.C. recommendation No. 13 last year. These objectives involve the implementation of the following two-part incentive program:

- a) A Federal Government-sponsored insurance plan to enable coverage of 75% to 85% of the inherent risk involved in the "idea to hardware" development phase of all inventions whose merits have been evaluated under the scheme as being worthy

THE BOSTEX CORPORATION LIMITED (Cont'd/...)

and capable of commercialization to help foster our national industrial and trade objectives as summarized herein.

- b) A specific income-tax credit plan, including a reinvestment in Canada provision, for industries manufacturing new products based on new technology, and primarily, or exclusively, export-oriented.

Dr. A. J. Bobkowicz
Vice President Research &
Development

CANADIAN NATIONAL RAILWAYS

Your interest in contacting CN in this regard is appreciated. Canadian National Railways is a transportation company securely based in science and engineering and operating as a vital element of our commercial and industrial society. CN is one of the world's largest transportation organizations. In addition to its 25,000 miles of mainline track, which is more than any other railway outside of the Soviet Union, it operates a fleet of coastal vessels, trucking subsidiaries, telecommunications networks involving telegraph, radio, television and teletype transmissions and a chain of hotels. With approximately 85,000 employees, it is the largest corporate employer in the country.

It is significant that transportation services (excluding private automobiles) represent approximately 6% of the gross national product and, therefore, transportation costs constitute an important portion of the physical distribution costs of manufactured goods and other commodities in this country. It is obvious that research which contributes to a reduction in the cost of railway and other transportation operations will inevitably be reflected in minimum costs of transportation to manufacturers and shippers and no elaboration is needed of the beneficial effects of the lowest possible costs of transportation in Canada's position in the export market place.

Because of the importance of transportation to the economic and social welfare of Canada, it is considered that several significant steps could be taken to enhance research in the transportation field, having particular regard to railway operations. Among these are:

1. Increased participation of Universities, Provincial Research Councils and other research organizations with industry in scientific research in the transportation field.
2. Increased participation of federal agencies.
3. Broadening of the scope of federal assistance to research in industry
4. Establishment of a national organization for research in soils dynamics.
5. Establishment of a transportation research information center.

M. Archer
Vice President, Research
& Development

COLLEGE MILITAIRE ROYAL DE SAINT-JEAN

I would like to mention a research activity at C.M.R. that might be the kind of thing you are interested in.

The research conducted by Dr. Favreau on explosive shock waves, has three main applied aspects, as follows:

A. Structural Engineering

Purpose: To assist in the design of structures that will likely have to withstand shock loading.

Tools available:

- (i) A computer program to calculate the parameters of shock waves from explosions in air or water.
- (ii) A theory that converts the data of (i) into an "effective static stress" suitable to assist the engineer in his design work

B. Mining Engineering

Purpose: To supply the Canadian mining and quarrying industry with:

- a) theoretically optimized blasting procedures, and
- b) theoretically optimized mine excavation designs.

Tools available:

- (i) A new theory that predicts the action of any explosive on any rock, in terms of the combined properties of the explosive and rock.
- (ii) A computer program that calculates the partition of the explosive energy during blasting; refinements of this program are underway.
- (iii) A computer program is being prepared to obtain rapidly a reasonable estimate of the stress field developed in rock in the presence of mine shafts, excavations, etc.

C. Space Technology

Purpose: To investigate the commercial possibility for Canada to launch very heavy (100-200 ton) satellites by means of explosively loaded boreholes in rock.

Tools available:

- (i) The new theory described in part B.(i) has been used to show that theoretically such launches are economically viable. Plans are being started to verify experimentally the truth of the above calculations.

COLLEGE MILITAIRE ROYAL DE SAINT-JEAN (Cont'd/...)

We believe that this research could be associated with the first objective of Report No. 4 of the Science Council of Canada, namely National Prosperity.

M. A. Benoit
Dean of the Faculty

CONSOLIDATED-BATHURST LIMITED

I would make the following suggestions for national objectives for science and technology:

1. Assist development of primary and secondary industry by establishing proper incentives for innovation and technical risk-taking.
2. Solve problems of air and water pollution facing industries and municipalities.
3. Development of a more temperate and less seasonal climate for Canada in order to
 - a) make northern areas more habitable,
 - b) extend the growing season for Canada's forests and agricultural products and thereby make the related industries more competitive with those in the U.S. and other countries.

Alan H. Vroom
Director of Research &
Development

DOMINION TEXTILE COMPANY LIMITED

Our company's opinion is as follows:

1. We do not believe that much concrete benefit can be realized to Canadian Industry and therefore the country as a whole by establishing and working towards nebulous goals, rather we believe that specific situations that require improvement should be included in these objectives if you proceed.
2. There are several areas in the Textile Industry which are peculiar to Canada that might bear analysis. We imagine that these areas have equal application in several other industries. They particularly apply to the very cold climatic conditions that exist in this country.

DOMINION TEXTILE COMPANY LIMITED (Cont'd/...)

a) Heat Recovery

We hesitate to guess even at the magnitude of money that is spent in fuel every year in Canada to preheat make-up air in various types of process in the Pulp and Paper Industry, Textile Industry, etc. Practical studies of how heat recovery, air to air, air to water, etc. can be achieved to minimize this loss would, in our opinion, greatly benefit our industry.

b) Roof Design

We believe that roof design in this country still has a long way to go before the problems that are experienced in industry reach reasonable proportions.

c) Wall Design

The same comments as applied to roof design above also apply to wall design.

Arthur P. Earle
Vice President, Operation
Services

DUMTAR LIMITED

In commenting, it will be useful if we refer to Report No. 4, dated October 1968, by the Science Council of Canada "Towards a National Science Policy for Canada". You will have read this Report and, as you know, in it, the Science Council outlined broad guidelines for the future use and development of science and technology in Canada and linked these directly to six specific National Goals. In developing these goals and in identifying the main elements required to achieve them, and including the contribution of science and technology, the Council has, I think, sought and considered advice from many sectors of society, and one can hardly do better than to subscribe to these guidelines.

From a commercial point of view it is probably logical to give added weight to the two specific goals dealing with national prosperity and with a high and rising standard of education while not forgetting a third goal - health - and the improvement of the environment in which we live.

DOMTAR LIMITED (Cont'd/...)

We note too, that the Science Council places special emphasis on the need to do more research and development close to the point where the innovation will be initiated and with an increasing share of the research and development being performed by industry and by the universities with government financial support. This suggestion, of course, parallels the second point brought out in your Engineering Institute Brief. It is also consistent with the recommendations made in the Brief submitted by the Canadian Pulp and Paper Association to the Science Secretariat last Fall with respect to industrial research and development in Canada. Domtar Limited, being heavily involved in the pulp and paper business, participated in the development of this Brief. The opinions expressed therein and covering industrial research incentives, university research and training programs, and government contract research, are, we believe, applicable to industry at large.

A. E. Penney
Vice President,
Engineering, Research &
Development

S. McNALLY & SONS, LIMITED

The need for a complete new systems approach to urban sewers is very justifiable and urgent at this time, for the following reasons:

1. To control pollution, a two-pipe system is rapidly becoming universal, i.e. separate storm and sanitary sewers.
2. These sewers can most conveniently be laid in one trench.
3. All existing pipe manufactured is based on individual pipe system. All trench designs, and manholes designed, are adaptations of single-trench philosophy.
4. The single-trench-system thinking leads to a proliferation of mixed pipe sizes. The only way to get a sensible two-pipe system is to start from the beginning and eliminate some of the many special sizes and fittings that are all too often adaptations of the original mortar-joint clay pipe systems.

P. J. McNally

WESTERN MINES LIMITED

From your third paragraph I gather you want suggestions for specific lines of study. Western Mines have a difficult problem in differential flotation, in common with other mines with similar ores. I therefore suggest that there should be a continuing study of flotation from the standpoint of fundamental science as well as in its technical aspects.

W. G. Jewitt
President

McGILL UNIVERSITY - FACULTY OF ENGINEERING

The development of technological aids, in particular the development of computer terminal equipment and of educational software, may be the only way in which Society can cope with the increasing numbers who require education. The development of technological aids will develop into a multi-million dollar business and in which Canada should take a significant role.

No really serious impact has been made by technology on teaching methods. It is remarkable that nearing the end of the 20th century we still hail the overhead projector as a fundamental advance in teaching methods, and yet this device was used by several universities in the late 1920's.

The work of the Bell Laboratories in developing computers which can both be talked to and talk back are still some way from fruition, but are, nevertheless, an interesting portent of what may be the future. It is not in the field of large general purpose computer development itself where the major Canadian effort is required, rather it is in the development of the terminal equipment, the man-machine interface that Canadian skill and manufacturing effort should be concentrated.

G. L. d'Ombain
Dean of the Faculty of Engineering

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED

Canada by virtue of its plentiful supply of natural resources, its location, large area and relatively small population has unique requirements from the standpoint of the development of a science and technology policy. A policy which is to serve under these circumstances must have well established objectives.

1. The national effort should be concentrated on the development of natural resources and natural resources based industries. Activity in these areas should form the basis for the development of the Canadian economy.
2. Exploration and development of Canada's vast resources of petroleum and allied materials should receive high priority, not only from the standpoint of potential energy supply, but more importantly as a source of supply for the production of organic chemicals. It would seem preferable to develop nuclear fuels as a primary source of energy.
3. Because of Canada's small population, its high standard of living and its rapidly developing social conscience the funds available for scientific and technological development will be severely limited. Such funds as can be made available must therefore be spent in the most productive areas. In short, Canada's science policy, at least for the short term future, must be mission oriented.
4. In a negative sense, Canada should not become seriously involved in space programmes. Such expertise as might be desirable in such areas as communications should be acquired from the United States. Similarly, other costly, ambitious programs such as deep sea exploration should be on the basis of modest participation with U.S. agencies.

I appreciate the opportunity of contributing to the brief that you are preparing.

Louis S. Renzoni
Vice-President, Process Research

CANADIAN BROADCASTING CORPORATION

Technical National Objectives for Canada

1. An intensive scientific study should be carried out to determine what should be done to improve living conditions in Canada, particularly for those with low incomes. Basically the study should determine how best to use our manpower and resources for the benefit of all. Just as the "man on the moon" project in the U.S.A. required the contributions of experts in almost all fields of knowledge, in the same way would a "man on the earth" require input from all fields of human experience.
2. There is a growing awareness of the inadequacy of our educational system. One of the causes of student unrest is that universities have so many poorly organized courses and incompetent professors.
3. A study should be made of urban development in order to determine the basic lines along which cities should be planned.
4. The development of Prefab Construction techniques directed especially to home construction, but possibly applicable to some degree to apartment and business buildings. This would require standardization of building codes and revision of many existing regulations.
5. A study should be made of the economics of keeping the St. Lawrence Seaway open all year.
6. The development of a space satellite capable of broadcasting radio and television signals directly to homes all across Canada would be a worthwhile project.
7. Cooperative effort between large operating companies and manufacturing organizations could result in new products which would be marketable abroad. For example, CBC engineers working closely with equipment suppliers have developed specialized radio and television equipment to meet operating requirements in Canada. Some of this equipment has proven so successful that it is now being sold to broadcasters in other countries.
8. The development of an effective and economical sewage treatment and disposal system would benefit the whole country by reducing the pollution of our lakes and rivers and hopefully reducing the cost of sewage disposal.

George F. Davidson
President

NORANDA RESEARCH CENTRE

The recommendations of the Science Council of Canada for large, mission-oriented national programs are undoubtedly sound, and, if properly administered, would lift the whole level of science and technology to a sorely-needed higher level. Their social and economic aspects should not be forgotten, in addition to their obvious technological objectives.

Of the programs recommended by the Science Council, I would place Transportation (in all its myriads of aspects) far ahead of the others. Urban Development would be in second place. I don't see how Computer Applications can be considered as a national objective. After all, it fulfills a service function, somewhat like mathematics does for the physical sciences. Since the use of computers underlies virtually all aspects of science, specialized applications and requirements should develop naturally, along with the other technological aspects of the respective programs. In other words, each program should have its own strong computer application section.

Canadian corporate management is quite willing to support relatively modest, short-range R. & D. programs. They are considerably more reluctant to support long-range programs, with lower probabilities of success and much longer pay-off periods.

Acceptance of these views - which are rather obvious - leads immediately to the concept of Industry Objectives, that is the support of medium-sized projects (say a few million dollars, spread over a period of three to five years) which a single firm is unable or unwilling to finance, but which would be of benefit to the whole of a given industry. A good example of such a program can be found in the mining industry where there is an enormous need for more efficient methods of detection of mineral bodies. Many geophysicists believe that we have now at hand the technological means to develop far more sensitive remote-sensing detectors. Such a program would conceivably require from five to ten million dollars, spread over a period of possibly three or four years. It would obviously benefit the whole mining industry in Canada and even an improvement of only ten percent in the resolving power of our present methods of detection would have far-reaching effects on the effectiveness of exploration. Many such programs can be visualized for a variety of Canadian industries. Administration and funding would be similar to that proposed above for the National Objectives.

It is my considered opinion that there is a very real need for such Industry Objectives. Because they would be more modest in scope, they could be implemented more quickly than the National Objectives, within the existing N.R.C. machinery, while preparing the ground for the more ponderous organization of the larger programs.

W. H. Gauvin,
Research Manager

LITTON SYSTEMS (CANADA) LTD.

We believe strongly in the need for National Objectives to be defined and implemented. It will, of course, be necessary for the government to select a number of objectives from those suggested. Also in this process it would appear to be necessary that "in depth" systems studies would be required to establish feasibility, cost, method of attack and so on.

Dr. J. J. Green
Director of Government Relations

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First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 57

TUESDAY, JUNE 10th, 1969

WITNESSES:

Social Science Research Council of Canada: Yves Dubé, President, H. G. Thorburn, Immediate Past President, J. R. Mallory, Past President; Canadian Economics Association: Dr. William C. Hood, President, Mr. G. L. Reuber, Past President; Canadian Association of Geographers: Dr. F. Kenneth Hare; Canadian Sociology & Anthropology Association: Professor Richard Salisbury, President-elect, Professor Frank E. Jones.

APPENDICES:

- 119.—Brief submitted by the Canadian Association of Geographers
- 120.—Brief submitted by the Social Science Research Council of Canada
- 121.—Brief submitted by the Canadian Economics Association
- 122.—Brief submitted by the Canadian Sociology and Anthropology Association

MEMBERS OF THE SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

“With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

TUESDAY, June 10, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 10.10 a.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Bourget, Grosart, Haig, Kinnear and Yuzyk—8

In attendance: Philip J. Pocock, Director of Research (*Physical Science*)

The following witnesses were heard:

SOCIAL SCIENCE RESEARCH COUNCIL OF CANADA

Yves Dubé, President.

H. G. Thorburn, Immediate Past President,

J. R. Mallory, Past President.

CANADIAN ECONOMICS ASSOCIATION

Dr. William C. Hood, President,

Mr. G. L. Reuber, Past President.

CANADIAN ASSOCIATION OF GEOGRAPHERS

Dr. F. Kenneth Hare.

CANADIAN SOCIOLOGY & ANTHROPOLOGY ASSOCIATION

Professor Richard Salisbury, President-elect.

Professor Frank E. Jones.

(*A curriculum vitae of each witness follows these Minutes*)

The following briefs are printed as appendices:

No. 119—Brief submitted by the Canadian Association of Geographers

No. 120—Brief submitted by the Social Science Research Council of Canada

No. 121—Brief submitted by the Canadian Economics Association

No. 122—Brief submitted by the Canadian Sociology and Anthropology Association

At 12.50 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie

Clerk of the Committee

CURRICULUM VITAE

Dubé, Professor Yves, B.A.: 1944, B.Sc. (Phys.) (Laval): Dean, Faculty of Social Sciences, Laval University and Vice-Chairman of the Canadian Research Council on Social Sciences. Mr. Dubé was a member of the following: the Secretariat of the Royal Commission on Canada's Economic Prospects (1955-1957); the financing group of the Economic Advisory Council of the Province of Quebec (1963); the Provincial Town Planning Commission (1963); the Economic Council (1963-); the Canadian delegation to the Unesco Congress (1964); the Commission on University Financing (1964-1965); the Education Committee of the Department of Manpower and Immigration (1967). In 1954, he was named Statistical Adviser to the Royal Commission on Constitutional Problems. Mr. Dubé was also a member of the Canadian Institute of Public Affairs (Vice-President, 1962-1966), of the Canadian Association of Economists (President, 1962-1963) and of the Canadian Association of Political Scientists (Vice-President, 1965).

Hare, Frederick Kenneth: Born February 5, 1919. B.Sc., King's College, University of London 1939. Ph.D., Université de Montréal, 1950. Hon. LL.D., Queen's University (Canada) 1964. Hon. LL.D., University of Western Ontario (Canada) 1968. F.K.C. Fellow of King's College London, 1967. Lecturer in Geography, University of Manchester, England: 1940-41. War Service in British Air Ministry: Operational Forecaster, Meteorological Office: 1941-45. Assistant and Associate Professor of Geography, McGill University, 1945-52; Professor, 1952-64. Chairman of Department of Geography, McGill University, 1950-62; Dean of the Faculty of Arts and Science, McGill University: 1962-64. Warden of Peterson Residence, McGill University, Montréal, 1946-50. Professor of Geography, King's College, University of London: 1964-66. Master of Birkbeck College, University of London: 1966-68. President, The University of British Columbia, Vancouver, B.C., 1968-69. Professor of Geography, University of Toronto: July 1, 1969. Member, National Research Council of Canada, 1962-64. Chairman of Board, Arctic Institute of North America: 1963. Member, Natural Environmental Research Council: 1965-1968. Hon. Fellow, American Geographical Society, 1963. President, Association of American Geographers, 1964. President, Canadian Association of Geographers: 1964. President, Royal Meteorological Society, 1967-68. Vice-President, Royal Meteorological Society, 1968-. Fellow of the Royal Society of Canada, 1968. Fellow of The Royal Society of Canada, 1968. Director, Resources for the Future, Inc., 1969. Author of: *The Restless Atmosphere*: Harper & Row, New York; 1953. *On University Freedom*: University of Toronto Press: 1968.

Hood, Wm. C.: Born: Yarmouth, Nova Scotia, 1921. Education: B.A. Mount Allison University. M.A., Ph.D., University of Toronto. Career: Instructor in economics, University of Saskatchewan, 1944-46. Teaching staff, University of Toronto, 1946-64, with rank of Professor of Economics from 1959. Adviser, Bank of Canada, from 1964. Assistant Director of Research of the Royal Commission on Canada's Economic Prospects, 1955-56. Director of Research and Economic Adviser of the Royal Commission on Banking and Finance, 1961-63.

Elected a Fellow of the Royal Society of Canada, 1963. President, Canadian Economics Association 1969-70.

Jones, Frank E.: Born—Montreal, on October 28, 1917. Academic Training: McGill University 1946-1949, B.A., (Sociology). McGill University 1949-1950, M.A. (Sociology). Harvard University 1950-1954, Ph.D. (Sociology). Membership in Professional Organizations: American Sociological Society. Canadian Political Science Association, Member of the Executive Council 1954-1956; Member of the Executive, Anthropology and Sociology Chapter, 1956-1958; Chairman, Anthropology and Sociology Chapter, 1958-1959. Canadian Sociology and Anthropology Association 1966- Member of the Executive, 1967-1968; Editor, Canadian Review of Sociology and Anthropology, 1968- Defence Research Board—Member 1962-1964;—Chairman, 1964-1966 Sub-Committee on Sociological and Social Psychological; Research, Human Resources Research Advisory Committee. Commonwealth Academic Exchange Committee of the Humanities and Social Science Research Councils, Member, 1962-Canada Council, Selection Committee, 1966-1967. Employment: 1948-1949 Teaching Assistant, Department of Sociology, McGill University. 1949 (Summer), Research Assistant, Economics and Research Branch, Department of Labour, Ottawa, Ontario. 1949-1950, Teaching Assistant, Department of Sociology, McGill University. 1951-1952, Research Assistant to Talcott Parsons, Department of Social Relations, Harvard University. 1952-1953, Research Assistant to Talcott Parsons, Department of Social Relations, Harvard University. 1951 (Summer), Scientific Officer, Defence Research Board, Ottawa, Ontario. 1952 (Summer), Scientific Officer, Defence Research Board, Ottawa, Ontario. (During the above period, I was a member of a team engaged in sociological research in Infantry Training). Sept. 1953-Sept. 1955, Chief, Research Division, Canadian Citizenship Branch, Ottawa, Ontario. Nov. 1954, Research Consultant, Department of Social Relations, Harvard University (on leave of absence from my position in Ottawa to fill the above appointment). 1955-1959, Assistant Professor of Sociology, McMaster University. 1958-1965, Chairman, Department of Sociology, McMaster University. 1959-1964, Associate Professor of Sociology, McMaster University. 1964- Professor of Sociology, McMaster University. 1956 (Summer), Visiting Professor of Sociology, University of British Columbia. June 1961-Dec. 1961, Visiting Fellow in Sociology, Australian National University. 1966-1967, Visiting Professor of Sociology, McGill University. 1967 (Summer), Visiting Professor of Sociology, University of British Columbia. Theses: "Work Organization in the Structural Steel Industry; A Study of Industrial Organization and of Ethnic Relations among Structural Steel Workers", unpublished M.A. Thesis, McGill University, 1950. "The Infantry Recruit; a Sociological Analysis of Socialization", unpublished Ph.D. Thesis, Harvard University, 1954. Unpublished Papers, Reports, etc.: "The Social Organization of Psychiatric Wards", Report of Project 605-5-294, National Health Grant, Ottawa, (mimeo) 1961. "The Social Bases of Education", Toronto: Canadian Conference on Children (mimeo), 1965 (also available in a French edition).

PUBLICATIONS:

"The Newcomers" *Food for Thought*, 14:6 (1954).

"A Sociological Perspective on Immigrant Adjustment", *Social Forces*, 35:1 (1956), pp. 39-47.

An Introduction to Sociology, Toronto: CBC, 1961.

"The Socialization of the Infantry Recruit" in *Canadian Society*, 1961.

"Personal Identity in Modern Society", *Ontario Psychiatric Association Newsletter*, No. 5, (1961) pp. 15-21.

"The Several Dimensions of Work", *The Commerecman*, 17 (1962).

"The Social Origins of High-School Teachers in a Canadian City", *Canadian Journal of Economics and Political Science*, 29 (1963) pp. 529-535, also published in *Canadian Society*, Revised Edition, 1964 (see below).

"Some Social Consequences of Immigration for Canada", invited paper, *World Population Conference*, 1965, V. 4 New York: United Nations, 1967. p. 207-210.

"Structural Determinants of Consensus and Cohesion in Complex Organizations", *Canadian Review of Sociology and Anthropology*, 5:4 (1968).

(With Jean C. Falardeau), "La Sociologie au Canada", *Transactions of the Third World Congress of Sociology*, 1957.

(With W. E. Lambert), "Attitudes Towards Immigrants in a Canadian Community", *Public Opinion Quarterly*, 23, (Winter 1959).

—"Occupational Rank and Attitudes Towards Immigrants", *Public Opinion Quarterly*, 29, (Spring 1965).

—"Some Situational Influences on Attitudes toward Immigrants", *British Journal of Sociology*, 23 (1967) pp. 408-424.

(With B. R. Blishen, K. D. Naegele and John Porter) *Canadian Society: Sociological Perspectives*, Glencoe: The Free Press, and, Toronto: Macmillan, 1961.

Canadian Society: Sociological Perspectives, 2nd revised edition, Toronto: Macmillan, 1964.

Canadian Society: Sociological Perspectives, 3rd revised edition, Toronto: Macmillan, 1968.

Mallory, James R.: Born in St. Andrew's, N.B. B.A. (Hons.) 1937, University of New Brunswick; LL.B. 1940, University of Edinburgh; M.A. 1941, Dalhousie University. Professor Mallory taught at the University of Saskatchewan, Brandon College, and University of Toronto before joining the Department of Economics and Political Science at McGill University in 1946. He was appointed Professor of Political Science in 1959 and was formerly Head of the Department of Economics and Political Science. Professor Mallory was President of the Social Science Research Council of Canada 1965-67. He is also a former Vice-President of the Canadian Political Science Association.

Reuber, Grant Louis: Born: Mildmay, Ontario, Nov. 23, 1927. Education: B.A. (Honours Economics and Political Science), University of Western Ontario, 1950; A.M. 1954, Ph.D. 1957 (Economics), Harvard University. Research Student, Cambridge University, 1954-5. Experience: Bank of Canada, Economic Research Department, Ottawa, 1950-2. Canadian Department of Finance, Economic and International Relations Division, Ottawa, 1955-7. University of

Western Ontario, Department of Economics, 1957-. Royal Commission on Banking and Finance, 1962-3. President, Canadian Economics Association, 1967-8. Leave of absence, Harvard University, 1968-9.

Salisbury, Richard F.: Born: December 8th, 1926, Chelsea, England. Married: August 28th, 1954, Toronto, Ontario. Three Children. Education: University College School, Hampstead, England 1938-45. St. John's College Cambridge, 1948-1951; B.A. (Modern Languages), 1949; Certificate of Competent Knowledge, Spanish, 1950 pt. II Tripos; Anthropology 1951. M.A. 1956 Harvard University, 1951-2 and 1954-6 A.M. 1955. Australian National University, 1952-1954 Ph.D. 1957. Professional Career: Research Associate, Harvard University School of Public Health, 1955-1956. Assistant Professor, Tufts University, 1956-1957. Assistant Professor University of California, 1957-1962. Associate Professor, McGill University, 1962-1965. Professor, McGill University, 1966- Chairman, Department of Sociology and Anthropology, 1966-. Professional Society Memberships: Fellow of the Royal Anthropological Society. Fellow, American Anthropological Association. Associate, Current Anthropology. Member, Canadian Sociology and Anthropology Association. Member, Polynesian Society. Member, American Ethnological Association. Member, Papua New Guinea Society. Professional Distinctions: Open Scholar, St. Johns College, Cambridge 1945-1951. Strathcona Research Scholar, St. Johns College, 1951-52. Arnold Fellowship, Harvard University, 1954-5. Secretary, San Francisco Bay Area Anthropologists, 1959-60. Member, Pacific Research Committee, U.S. National Academy of Sciences/National Research Council, 1965-67. Executive Committee, Canadian Sociology and Anthropology Association, 1965-. Chairman, NAS/NRC Conference on New Guinea Research August 1965. International Editorial Advisory Board, *Ethnology*, 1964-. President-elect, Northeastern Anthropological Association, 1967-1968, President 1968-1969. Vice President, Canadian Sociology and Anthropology Association, 1967-. Research Experience: Fieldwork, November 1951-November 1952, Siane tribes of the New Guinea Highlands (as A.N.U. Research Scholar). Study of State Mental Hospital, Boston, June 1955-June 1956. Fieldwork, January 1960-December 1960, Tolai people of New Britain (Research Grant MH4912 of U.S.P.H.S.). Fieldwork, September 1960-January 1961—revisiting of Siane tribes in New Guinea (research grant MH 4912). Fieldwork, April-May 1964, Wapisiana Indians of interior British Guiana (with Professor T. L. Hills). Fieldwork, May 1965, + May-June 1965, Mackenzie, British Guiana (grant from McGill Centre of Developing Area Studies to study a mining town. New Guinea Research, May-December 1967, at University of Papua and New Guinea, continuing Siane and Tolai research, commencing study of Bougainville copper mining.

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Thorburn, Hugh G. Born in Toronto; educated at Toronto Public Schools and North Toronto Collegiate Institute; B.A. 1949, University of Toronto; M.A. 1950, Ph.D. 1958, Columbia University. Awarded Certificate of European Institute for specialist work in French Government, June 1951. Other awards include grants and fellowships from the Social Science Research Council of Canada (1954, 1955), the Canada Council (1958-1960, 1963-1964, 1968), and Queen's University. Before joining the Department of Political Studies at Queen's University in 1956, Professor Thorburn had taught at Mount Allison University and the University of Saskatchewan. He is now Chairman of that Department. Professor Thorburn is the author of numerous articles which have appeared in such publications as *Canadian Journal of Economics and Political Science*, *Dalhousie Review*, *Canadian Commentator*, *Canadian Forum*, *Queen's Quarterly*, *International Journal*. Professor Thorburn has been the President of the Social Science Research Council of Canada since June 1967.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 10, 1969

The Special Committee on Science Policy met this day at 10.10 a.m.

Senator Maurice Lamontagne (*Chairman*) in the Chair.

The Chairman: Honourable senators, this morning we will follow our usual procedure. We shall ask a spokesman representing each association, group or council before us to make a short opening statement, and then we will have a question period. The question period will be as informal as possible. Those of you who are members of any of these delegations here this morning are free to participate at that stage in the discussion and to answer questions should you feel that you want to add to what your spokesman has said. You are also free to make comments as we go along, so please feel free to participate. This forum is not restricted to the spokesman of your groups or associations.

Without any further comment I shall ask Dean Dubé, the new President of the Social Science Research Council of Canada to make his opening statement.

Dean Yves Dubé, President, Social Science Research Council of Canada: Thank you, Mr. Chairman. I must tell you at the outset that the Social Science Research Council is very happy to appear before you. It is conscious of the great work that you have been doing and it is very glad to receive such wide support for the work across the country. It happens that I am a new president of a new association, because last Sunday the Canadian Social Science Research Council adopted a new constitution and appointed me president.

The Chairman: Was there a long discussion?

Dean Dubé: It was cut short. I am in the position of a Quebecker who has the time to play with the new constitution. Our constitution provides that the basic disciplines in the field of social science be represented in the

council and that there be not more than three members from the discipline of anthropology, economics, geography, history, law, political science, psychology and sociology. Other disciplines will be brought in if they are qualified. This will have to be decided by two-thirds of the members of the basic disciplines.

If you want, Mr. Chairman, we could table a copy of the new constitution. We feel strongly that this constitution now provides the social sciences with the machinery that they need in order to act as a group and a Social Science Research Council will be, in a sense, a qualified spokesman for the common interests of the basic disciplines. Of course, each of the disciplines would speak for itself when it is the only one concerned.

The Chairman: You would leave them a certain degree of autonomy.

Dean Dubé: That is right. I thought it was important to point this out, at the outset.

Accompanying me is Professor Thorburn, who was president of the Research Council before me, and Professor Mallory, who has long been connected with the Social Science Research Council. These two people were more concerned than I with the preparation of the brief and, with your permission, I will ask them to add some comments.

Looking at the brief, you can see that we put much emphasis on the inadequacy of funds for social science research in Canada. This is not new to you, you have been told this many times and this is a point which was made also in the Macdonald Report.

We lack the funds for social science and these funds need to be increased rapidly.

We would also like the funds distributing agencies to be kept as numerous as possible. I would like the Canada Council to have much more money to support basic research in social science. I was afraid that, with the accent being put on mission-oriented research today, the development of basic research may

be neglected. This does not mean that we are not ready to endorse our responsibilities when it comes to mission-oriented research. Social scientists in this country feel that they have a responsibility to help in the solution of the social problems and the big social problems, the new problems that are confronting the country as a whole. We stand ready to help Government departments and the Government, if they want our help.

Since the brief was written, the Macdonald Report has appeared. This has led to more discussion about the position that we were to take here and we have changed our position a little on some points. We now have a representation on the Science Council, but we would like to have the social science and the humanities being represented on the same basis as the natural and health sciences. When I say "on the same basis" I mean that it should be half and half.

Of course, it is not a separation, one must not consider this division as a rigid one. There may be some people in the natural sciences who have an interest in social science, and vice versa. But this is our basic attitude now, that the Science Council should continue to exist but that its composition should be modified.

Another position that we are taking now is that the Canada Council should continue to have the same responsibilities as it has and that, for the time being, it should not be broken down between the two councils, one for the arts and one for the social sciences. We think that the Canada Council has done an excellent job as a fund distributing agency and that it has developed the proper machinery to distribute its funds and to control the use of the fund.

The Chairman: When have you been last seen?

Dean Dubé: We met with the Canada Council—with the chairman.

About both these agencies, we would very much like to be consulted about the appointments. As far as the councils are concerned, as to the relationship between the councils and Government and ourselves, we are ready to stand as spokesmen for the social science, to make known the priorities of the social scientists engaged in academic work. We would like to be able to express our views to the different bodies as often as possible.

We have not given much attention to what organization within Government should be

responsible for these councils, or to what minister the Science Council should report. I suppose there should be one minister, different from the Prime Minister. It is not necessarily the case that the Prime Minister should be the minister responsible. This last statement is a personal one. My colleague may well like to differ with me on that.

Professor H. G. Thorburn, Immediate Past President, Social Science Research Council of Canada: Mr. Chairman and honourable senators, what you have just heard illustrates the fact of life in Canada in these days, that the social sciences and the humanities are seen very often as relatively small fish in the overall question of research and knowledge.

I would like to emphasize that this is an area in which we need to catch up, in the field of the social science and humanities, in the specific studies done by professors relating to Canada in particular, whereas scientific research is universal.

Honourable senators, you know that when enacting legislation relating to social and economic life, one likes to have sound research on which to base one's deliberations and one's final enactments. We hope to impress upon you the need to increase support to the social sciences and humanities research, for this work, as well as to increase the area of effectiveness of this knowledge in Canada.

The terminology of research in social sciences and humanities is becoming increasingly expensive, because of the use of computers and survey research techniques, all of which are much more costly now than the old-fashioned, though still valid, library research methods of the past. Indeed, the libraries themselves now can obtain vast amounts of material if the money is available.

If we are to do the kind of research which will put—not keep, but put—this country into the forefront of research and accomplishment in social science, we must have very substantial increases in funds. At this point, it is not working funds for individual professors to do particular work, but support funds for the infrastructure necessary if this kind of work is to be done on a modern basis at all.

We have to have more adequate libraries. The Downs Report showed how inadequate our libraries are. We have to have centres of research which will enable us to tap the various sources of data in an organized way without duplication and unnecessary displacement of scholars. This is something that the Social

Science Research Council has been working on. We have just received a report by a committee of the Council on a data bank and research agency which would be costly to establish, but, once established, would make an enormous difference in the facilities available for social scientists to do their work effectively, with a minimum displacement and, therefore, with the greatest efficiency.

Now, this is something readily understood by a group such as yours, which has heard so much from the scientists, nationally. What we are asking for in this case is equipment—laboratory facilities. This is necessary.

The other side of our problem relates to personnel. On this question, frankly, we find that Canada is cheek by jowl with the wealthiest and most scientifically advanced nation in the world and, in a sense, is neighbourly with the other one across the Polar icecap. We have pretty stiff competition. It is very difficult for us to hold our best researchers and scholars. It is very difficult for us to draw on the best American and foreign or non-North American research scholars. This is because, for that small group of the very best people, we simply are not structured to offer salaries which are competitive with those that can be offered elsewhere.

I am not saying that the run-of-the-mill salaries for the, shall we say, ordinary university staff members are not, generally speaking, competitive. They might be slightly lower than the American ones, but the real gap, and I think the crucial gap, is in funds to make it possible to attract scholars of the first eminence to Canada to act as a leavening; to act as the vanguard and to organize research in the most modern and in the most sophisticated manner. Here I think is where we would ask that some kind of arrangements be made to make it possible for Canada to attract and hold scholars of the first quality.

I think the question of the support of research is something to which the Government of Canada has already committed itself. Mr. Pearson, as you know, said that he viewed the support of research as a responsibility of the federal Government. Therefore, we hope that we can encourage greater support for the Canada Council and for other research agencies which would make it possible to encourage scholars of international repute to take up employment in Canada because they would know that they would have the kind of support they want and need.

There are a couple of particular examples I could give of the short-fall of the prearrangements. As you know, the Canada Council does not, under its present structure, provide stipends for research scholars. This is not a question that I want to advance to you in the sense that scholars ought to receive stipends because they would like to. I am saying that, if we don't do this, we will find that the scholars will be drawn to the places where they do receive stipends. It has got to the position now where, in the United States, in the better and stronger institutions, research stipends are paid by research foundations, or professors who remain in their institutions during the period when they are not actually teaching—which is usually during the summer—receive a supplement to salary, if they do engage in research.

Clearly, researchers are going to be attracted to institutions that can offer this advantage over those that do not.

The Social Science Research Council has taken a position on the source of research funds so far as the granting bodies are concerned. We would hope that the Government of Canada would be able to funnel its research support not only through one agency, the Canada Council, but to some degree, at least, through others. Let me explain that, because I think on the surface it might appear somewhat irrational to do this.

The Chairman: Not only does it appear irrational, but it contradicts another one of your associations which apparently also belongs to the Council.

Professor Thorburn: I am aware of that, sir, and that is why I wish to explain it.

Senator Grosart: Is that not being done now? Is the Government not channeling its funds through many agencies now?

Professor Thorburn: If you consider contract or mission-oriented research, certainly. But, so far as uncommitted research goes, the bulk of the funds are now channeled through the Canada Council. Given the rather sensitive nature of some of the top topics dealt with by social scientists, and often the strong disagreements among social scientists as to what are sound methods or preferred methods or modern methods, I think it would be fair to social scientists who are committed to one particular method to be able to apply to more than one agency, because, if they are turned down by one agency because the people who have reviewed the application con-

sider the method employed by this social scientist not to be one they would have used, then, clearly, we could very easily become biased in our research methods and might take the wrong road. When it comes to research, we have to take more than one road, because very often one method turns out to be abortive or less productive than another. We must find the resources, I think, to experiment in more than one direction. It is for this reason that the Council has taken the view that we should see the funds channeled through more than one granting body. Of course, as Senator Grosart has said, this is already the case, if we are thinking of the more mission-oriented type of research.

However, I think the Social Science Research Council itself might serve in a modest way as a funding body. In a way it would be somewhat analogous to that fulfilled by the American Social Science Research Council to act as a kind of catalyst for research projects to undertake initiatives to get projects going. Once they are on the road, they could, of course, be financed through the regular Canada Council channels. One thing we seem to lack now is the machinery for bringing scholars together to initiate larger projects. We tend still to be mainly in the era of the initiative of the individual scholars. Very often projects are too large or require more than one perspective, if they are to be done on a large scale basis.

I think that is all I would like to say at this point, sir. I would call your attention to Professor Mallory.

Professor J. R. Mallory, Past President, Social Science Research Council of Canada: Mr. Chairman, I will be very brief, because there is little I wish to add at this stage to what has been said by my two predecessors. There are two points I wish to stress. The first of these is that there is a noticeable difference in the way in which research is supported as between the natural sciences on the one hand and the humanities and social sciences on the other. Practically every natural scientist is supported by some funding agency in this country. When we were young members of the academic community, Mr. Chairman, only a small number of humanists and social scientists were supported by funding agencies, and it is still true that only a small proportion of social scientists and humanists today receive support from a funding agency. If we want to increase the number of people and if research is to be adequately

supported, clearly we have to increase greatly the amount of support in order to provide for a very much higher proportion of active researchers than now exists.

Secondly, much of the push for research in this country has come and will come from mission-oriented research supported by the agencies of government which have problems they wish to be solved. This is inevitable and indeed desirable, but if most of the support for any kind of research comes only to mission-oriented research, I think it will lead to a very great misapplication of resources, because there has to be this counter-balance to provide sufficient money for research which may not be at the moment of interest to anybody but which is necessary to keep alive the scientific spirit and to keep the pool of intellectual activity going in areas not immediately of concern. I will give one example of this; when the Royal Commission on Bilingualism and Biculturalism started its investigations, the first thing it discovered was that there was practically no intellectual capital on which to draw, that the problems of second-language learning and much of the facts on which legislation could be based, and much of the social data in understanding the problem did not exist, and that the people to analyse it were not adequately trained. Had there been in the last decade adequate support for social scientists and humanists, I am sure that gap would not have existed.

I shall stop there because it is important to enlarge the area of discussion.

The Chairman: Thank you very much. Now we have Dr. Hood, President of the Canadian Economics Associations.

Dr. William C. Hood, President, Canadian Economics Association: Thank you, Mr. Chairman and honourable senators. It is a very great pleasure for the Canadian Economics Association to appear before this important body this morning to give their views on science policy in Canada in so far as it pertains to the economics profession.

At the outset let me say a word or two about our credentials for being here. The Canadian Economics Association is the association of professional economists in all of Canada, and it has close ties with the Association des Sciences Économiques which is also predominantly an association of professional economists. We have about 1,000 members and we support a journal with a subscription list of about 3,000.

Now, if I may say a word about the status of the brief; the brief has been prepared by a committee of the Executive Council of the association, and the Executive Council itself has approved the brief and therefore we are able to speak to you on the topics in the brief with the authority of the Executive Council of the Canadian Economics Association. The membership was informed at our annual meeting last week of the major points in the brief and there was no dissent. But I think it is correct to say that technically we speak for the Executive Council this morning, when we speak on matters in the brief. I should point out that if we get beyond the scope of the brief in later discussion, we will then be speaking as individuals.

The Chairman: And I am sure we will get beyond that.

Dr. Hood: I rather suspect we will.

Now, dealing with the substance of the brief, we have stressed one main point, and that is that there is a major national interest in the development and supplying of outstanding economic researchers in Canada, pure, applied and historical in their orientation. The question is the combination of policies necessary to achieve this objective, and we have drawn attention in the main to three. The improvement of the university environment is one. In that connection we have spoken, as, indeed, has the Social Science Research Council this morning, of the importance of having it nationally competitive so far as basic salaries, and, if you like the language, fringe benefits are concerned; in the nature of summer stipends which are also competitive, teaching loads that are comparable with our competitors, and ancillary facilities in the nature of computing facilities and libraries. We have dealt with all these things in the brief.

The second matter to which we have referred in connection with the main point is the financial support for graduate studies. We have suggested that this could be made more effective and we have discussed it at some length in the brief. I would attach great importance to this.

Finally we have given considerable attention to the need to attract established economists of proven outstanding ability and young scholars of outstanding potential. In this connection we refer to research professorships and the need for a central research

bureau, matters on which we would be glad to elaborate in the discussion to follow.

Perhaps I might terminate these brief opening remarks by drawing attention to a fact which might not be readily recognized unless one stops to think about the matter. This is rather a demographic fact in connection with the profession of economics in Canada.

I would not claim that the economists are unique in respect to the matter I want to allude to, but it is very important, and that is the age distribution of the core of people who today are practising as professional economists. On the whole, they are a very young group. The universities have been expanding their need for staff, as you know; the flow of students into the universities has been greatly expanded, and the staff has had to be expanded. The main source of that staff has been young people.

The Chairman: Do you mean that universities now, and especially the teachers in economics, have reached the post-Keynesian period?

Dr. Hood: Senator Lamontagne, I suppose I should desist from personal observations, but I shall never forget the day when in my class there were students who had not heard of Keynes and who has not even been in this world when he was working. The reason I bring this up is because the profession is weighted in this way. You have here the group of dynamic, energetic people just entering upon their highly productive period of research. I have gotten to the point where I feel it is safe to say that it is in the younger years that, by and large, on the average, researchers do their research, and there is, therefore, a considerable challenge facing this country now to see that these young researchers are given the scope to flower and to produce. I think that is very important.

The other point that I would make is allied to that. In order to retain their interest, to retain their domicile in this country, we must be competitive. The market in excellence is an international one. I believe it should be an international market, but whatever I believe, it is an international market; and if we are to compete in that international market for excellence, we have to be prepared to pay the price. I, of course, believe it important that we compete and that we compete well in that market. Thank you very much, Mr. Chairman.

The Chairman: Thank you, Dr. Hood. I want to emphasize at this point that Dr. Hood is a former Professor of Economics at the University of Toronto, but I also want to add, since he is asking for more money this morning, that he has become, during the last few years, a senior officer of the Bank of Canada.

Now we will hear from the Canadian Association of Geographers. Who will speak on their behalf?

Dr. F. Kenneth Hare, Canadian Association of Geographers: I am the spokesman for the association, Mr. Chairman, and they have asked me to present the brief to this committee. The president and secretary of the association, Professor Ludger Beauregard and Dr. Frank C. Innes, are both present also.

The brief that I prepared for the association to you is pretty limited in scope. It addresses itself specifically to one of the questions I think is before you, which is the role the learned societies can play in science policy formulation. It does not go into questions that others have raised, but I would like to say that if members press us to do it, we would say much the same thing about our own profession as have the economists about theirs.

The membership of the association is round about 500 full members and approximately 400 students and associates. It is the professional body. It represents those who call themselves geographers and obtain their living as geographers in Canada. It does the usual things the learned societies do: it publishes a journal, holds meetings and has occasional moments of disagreement.

The point we raise in the brief is this, that we believe that a learned society such as the Canadian Association of Geographers, because it does represent pretty broadly one of the professions of the country which touches on science policy, would like to have a mechanism whereby it can from time to time be heard on questions touching science policy. We think that a discipline which is having to do broadly with the use of land and the colonization of territories, urban systems, most of which are extremely close to the policy initiatives of central government, is relevant to the interests of the central government, and that it would be in the public interest, as well as in our professional interest, if there were a suitable mechanism of consultation.

Such a mechanism, in our case, does exist between the central government and the

profession, in that there is an advisory committee whose terms of reference and functions are described in the brief on pages 6 and 7. This is a committee which brings together senior officials of the federal Government—predominantly from the Department of Energy, Mines and Resources, whose minister is the closest minister we have with whom to make a point of contact—and professional geographers from all walks of the profession's life—university teachers, businessmen, civil servants. It meets regularly, and its function is to co-ordinate and to regulate geographical research in the country. It speaks from the Government to the profession, as it were, and in the brief we suggest that when the profession has things it would like to urge upon the Government that pertain to science policy, this same committee, perhaps under slightly different auspices, might very well serve in this reverse direction to carry advice from the profession to the central government on issues about which we feel strongly.

The Chairman: Do you not think it is a little incompatible?

Dr. Hare: It may be that there is some incompatibility. I think perhaps we were impressed by the fact that this committee has functioned extremely well from our point of view. It has done a good job, and I think it has made a big difference to the coherence of the geographical research across the country. Perhaps because we think it works well for our profession, we think it might work equally well in the opposite direction; but, of course, we are open to argument on that.

Finally, in the brief we say that the various statements the association has made in the past—for example, to the Macdonald Committee and to other bodies of a competent sort—are broadly consistent with the views raised by the Science Council in its briefs on this subject to you and to others. We feel that the policy that the federal Government should assume in the use of science in improving the national life has certain special qualities in Canada which might not be true of a small and densely populated country.

In brief, we think that resource development, and territorial exploration and expansion, are matters in respect of which Canada has special skills to tap and deploy, and that these ought to be made the maximum possible use of legislatively and administratively. This is now the case, in fact, to some extent, but we would like to see this use accelerated

further. The brief of the Science Council does say this, and we support it.

The Chairman: Thank you, Professor Hare. Finally, we shall hear from the Canadian Sociology and Anthropology Association. Professor Salisbury?

Professor Richard Salisbury (Canadian Sociology and Anthropology Association): Mr. Chairman, much of what is in our brief has already been referred to in the briefs of other associations, and that of the Social Science Research Council. Our brief was organized or prepared in the same way as both Dr. Hare and Dr. Hood have described; that is, by the executive council of our association. Its main recommendations were discussed by the association at its last meeting but, essentially, I am speaking on behalf of the executive council of the association and as the new president of the association.

We are an organization of about 500 scholars, representing perhaps 70 per cent of the people with M.A.'s or Ph.D.'s in Canada who are engaged in teaching, research, and Government administration in the disciplines of sociology and anthropology.

I myself am an anthropologist, but if there are any personal opinions to be given in reply to questions, then I would like to refer those questions to my colleague, Professor Gones who is a sociologist from McMaster.

Our brief contains five recommendations, four of which largely concern the mechanics of grant-giving, our relations with the Canada Council and the Social Science Research Council, and the need for the infrastructure support for research, and as a component of the training of personnel.

All of these recommendations fit in extremely well with what Dean Dubé, Dr. Hood, and Dr. Hare were saying. Since they have said what they have said, I do not feel that we need to repeat it.

I would, however, like to make a special comment on our first recommendation, which is:

That the Federal Government appoint in the research branches top grade staff and consultants, trained in sociology and anthropology, who can define the research that is needed by the federal Government and who are in touch with the latest developments in the Social Science disciplines.

We are a comparatively new discipline—in Canada, at any rate. Our size has quadrupled

over the last few years. The result has been that out of a membership of roughly 500 senior people there are, as of the survey which was made in 1967-68, only 45 people employed in the federal Government, and 23 in provincial Governments. What this has meant is that those Government departments that could use research that can be done by sociologists—and I think this is very much the case with geography too—have been deprived of it. As Professor Hare said, geography as such has a contact with natural resources. We have had virtually no contact with people in the federal Government. Most federal Government departments have had only one or two people at the most who can relate to the sort of research that sociologists and anthropologists have been doing. The result has been a tendency to under-utilize the research that is available, and not have the contacts that can create those large mission-oriented projects that, in fact, provide so much of the infrastructure for research training, and the on-going conduct of research that is so badly needed.

Professor Mallory was talking about the Royal Commission on Biculturalism and Bilingualism, and the fact that there were not sufficient research workers available when the commission started, and that a lot of time had to be spent in preparing research workers. Many of these functions would have been performed earlier had there been people available in the federal government departments to commission the research.

A more dramatic example I would have quoted would have been the experience with ARDA. Before it could get to work in Gaspé with its BAEQ project for Gaspésie, ARDA had to spend roughly \$2 million in order to secure the basic descriptive research that it needed in order to make its plan. In fact, much of that \$2 million was utilized inefficiently, because there were not the people available within the Government departments to plan research who were in contact with the academic basic research that was going on, and which had been financed by this tremendous increase in the social science support that had come from the Canada Council previously.

Our main point would be not that you should have people who are necessarily doing research in federal Government departments, but that you have people who are in touch with the academics and the wider profession, and who know who is doing what at the universities, and who are aware of the

findings of the university researchers, and the researchers in independent institutes. If there were such people then those findings could be utilized to a much greater extent.

As Professor Hare has said, if there is one department relative to a particular discipline, then this is perhaps the ideal situation. In fact, there are hundreds of agencies such as the Department of Manpower and Immigration, D.B.S., and the Defence Research Board, that can utilize social science research. There is insufficient co-ordination, insufficient tie-in to the disciplines, insufficient preparation of the personnel who will fit into this, and insufficient research funding. All of this could be corrected if academic research and Government research could be tied together in a much closer way so that the total research could be co-ordinated with the research personnel available.

I would like to leave our presentation at that point, since it does overlap so much the other presentations.

The Chairman: Thank you very much.

Senator Grosart: There are several questions that arise from these briefs, Mr. Chairman, that seem to relate very much to the main consideration before this committee, namely, a national science policy. Anybody who has read the reports of our meetings will appreciate that we have had some difficulty in nailing down the advice that has been so generously given in respect to the question of a national science policy. One of the reasons why this is so—and it runs through these particular briefs that are before us now—is that there is a fear in the science community of what has been described in various terms as a monolithic federal Government structure.

First, I wonder if anybody would care to comment on the basic problem of how we can get an input of thinking of the science community into national science policy if we do not have a political structure, other than with the present ad hoc historically developed set of agencies. Perhaps it is an indication of its dimension and the confusion of the dimension that the last speaker began to refer to "thousands of agencies" and corrected himself to say hundreds. It has also been suggested by, I think, Professor Mallory, in the discussion that it is a good thing to have a list of doors open for fund-seeking science disciplines to be able to shop around from one agency to another. I wonder whether this really is a viable way of developing a national science policy. Could somebody clarify for me the

real objection to having a national science policy in structural terms?

Dean Dubé: I could try. When we talk about science policy, I think we talk about establishing priorities for research. This is what the policy is to me. You have to talk about, for instance, monetary policy and decide what should be done first rather than something else.

Senator Grosart: If you do not mind my interrupting at this point, that is the answer that is usually given, and it confuses me for this reason. If you made a list of priorities taking into consideration the considered advice we have had in some 60 or 70 briefs, it would contain 200 or 300 priorities. When you refer to priorities, are you suggesting listing in order the 200 or 300 specific demands that we have had for immediate action by the federal Government, giving each one a priority number. What do you mean by priorities? It is a very easy, facile type of expression. What do you mean?

Dean Dubé: I would think of them as broad priorities. The Science Council should establish broad priorities for the encouragement of one field of research rather than others.

Senator Grosart: Please excuse me again because I want to clarify that. Does this mean some should be discouraged?

Dean Dubé: I think so.

Senator Grosart: Which? This is a question that national science policy must answer. It is a specific question. Deciding the degrees of encouragement must be a political decision. The ideal would be to have the absolute maximum of advice from the disciplines, an overview from the scientists, but in the final analysis it is a political decision.

The Chairman: That is why Dean Dubé does not have to take the decision this morning.

Dean Dubé: I was going to say that the politician should take the decision, and he should take the blame for it.

Senator Grosart: He does. This is the whole problem, if I may say so, that he must take the blame. If \$100 of science research funding goes to a town jester in Vancouver the blame, if there is a blame, comes back on the politician. It is debated in the House of Commons and the minister is embarrassed. This is the point. How do you get around it?

Dean Dubé: I am not a politician. Therefore I am not this morning going to tell you which field of research should be discouraged.

Senator Grosart: No, of course not. It was a rhetorical question.

Dean Dubé: When a decision is taken, broad priorities should be established. Many government departments may be interested in particular fields of research; they have their own decisions to take, on the basis of research we hope, and if more research goes into the decision-making process we stand a good chance of having a good decision. This is a complicated process. There have to be broad decisions, specific decisions based on specific research. For our part, we have our own preoccupations, we have our own priorities and these also have to be known. We therefore must have a confrontation of different points of view in this process. I do not think we can approach it in a simplistic way and say that one man must be responsible. There are a great many individuals concerned, in government departments, associations and so on.

The Chairman: This is the old mechanism of supply and demand.

Senator Grosart: Let me put the question another way, which will make it more specific. In many of these briefs this morning there has been a very strong emphasis, perhaps stronger than in most of the briefs we have had, on a much higher level of federal Government funding in basic or free research, whatever you wish to call it. It seems to me that if this is to be effective there will have to be an overall decision somewhere of the division of federal funding. I am speaking only of federal funding. Incidentally, I use "funding" in the broad sense. I notice there is a tendency to "fund" one thing and "grant" another. I am using "funding" in the broadest sense. Would anybody care to comment on the proposition that at a top political level, of perhaps a department of science policy, there should be a broad decision on the breakdown of federal funding between basic, applied and development research? Somewhere this decision has to be made. The question I would like to have answered as a layman is where this decision is to be made. Is it to be made in a generic way taking in the whole available fund, or is it to be a series of ad hoc decisions. In the end result, are all these decisions to be finally added up to see what we arrive at, or do we say of the total federal funding that so much

should go into basic research, so much into applied, development and innovation and then decide the disciplines?

The Chairman: We have two guests here and I would like to ask them to comment. Do you want to comment on this side too?

Dr. Hare: I was hoping to comment.

The Chairman: We will have the economics first.

Mr. G. L. Reuber, Past President, Canadian Economics Association: I think this is an essential question. I want to say, first of all, that I agree entirely with what Senator Grosart said. It is a political decision, and I do not think there is any escape from that. There is a danger in approaching the question from a mechanical way and in deciding exactly between applied research and pure research. Legally, I do not think it lends itself to that very straightforward approach. As a political decision it is clearly in order for the responsible group to have concerns about certain areas and to express and do things to support research in those areas. For example, in the case of political authorities being concerned about urban problems, there is no reason at all why they should not put emphasis on that and do so in a visible way. At the same time, however, I think that inevitably you are going to have to live with the community of scholars you presently have.

There is much to be said about supporting the kind of things that the community of scholars is prepared to undertake and does successfully. Consequently, I do not think it is a matter that lends itself to a clear answer, but it is something which requires you to recognize that the best research comes, in a sense, from the people who are committed to ideas and who have the will and capacity to develop that. In addition to that, I think you also have to take into consideration ones who wish to express a view about a particular area.

It depends on how you put the question. If you are putting it in terms of social science versus science, you may end up with figures of 6 per cent going to social science and the rest, more or less, going to other types of science. At that level you have a different kind of question than if you are deciding between finer divisions within the social sciences and perhaps amongst the sciences also.

The Chairman: Professor Hare has asked to comment.

Senator Grosart: May I make this one comment. I think it may clarify the further discussion. I shall quote you, if I may, Mr. Chairman on this.

The Chairman: You are not allowed to.

Senator Haig: He will do it anyway.

Senator Grosart: What we come back to is the fundamental debate (which the chairman has described in specific terms in a speech he made recently) between the "Republic of Science" theory that if you fund science adequately you can leave everything to the scientists because the natural process of scholarship will define the areas of interest and excellence. The chairman has called it the Republic of Science theory. The other is that you must have a social or political mechanism to provide guidelines and specific ones to the scientists. Now, Mr. Chairman, you have suggested that there should be a love affair developed between the two. I do not see very much chance of a love affair developing. I think you are going to have some pretty strict rules about the conduct of marriage. Whether there is love or not it does not matter very much. The main thing is that you must look after the children. This comes back to my question. Which way do you do it? Do you do it one way or the other or do you mix them? From a structural point of view you must make this decision.

Dr. Hare: After those remarks I am tempted to suggest that both science and Government have distinctly masculine principles, in which case the senator has introduced a rather awkward course to follow.

The Chairman: Even this may be allowed very soon.

Senator Grosart: It will be legal as long as there is consent.

Dr. Hare: I do not think there is any doubt. One cannot avoid the fact that decisions on the total level of science funding are political because it is so expensive. One cannot avoid this. I suppose one also cannot avoid the proposition that government and no one else but Government can, in the last analysis, decide on how much to spend. It is very difficult to make a distinction between pure and applied research. It is impossible in some fields. My own discipline is one—I stated this earlier in my brief—in which it is virtually

impossible and useless to make a distinction between pure and applied fields. It is easy in mathematics, but very difficult in geography.

The second point as to why difficulties arise in pure research is fundamentally something which tends to be in universities. It is part of the university process too and part of the republic of education, as distinct from the republic of science. If you start taking decisions on a science policy basis or about the level of pure research you are, by inference, taking decision on what goes on in universities and the educational field.

The Chairman: At this level, would not the Government be making decisions on what is going on in universities? Since it is one of the main sources of funding in research in universities, at some stage the Government and Parliament have to make decisions as to the amount of funding which will be made available to universities.

Dr. Hare: May I end by saying that I think it is important to have a body such as the Science Council, but much more broadly conceived than it has been. It should be able to advise the Government of an imbalance coming between pure and applied research. A political decision must be taken. I think the Science Council is too narrowly conceived. It should be located on things traditionally called sciences. It misses the point. Obviously a large part of what goes in the policy making is not physical and biological science; it is social science.

Senator Grosart: The problem here is that we are told that you cannot make a distinction between basic and applied science. Almost every brief we have had says to the Government that you must put more money into this or that category and at the same time we are told that you cannot describe the pockets but you must put more into the pockets all the same.

Professor Thorburn: I think, in response to your question, as to how much money goes into applied research, it depends entirely on the unfolding of events in the country and the Government's response to these. We become sensitive to a certain problem and I think it must be studied. The Government sets up a royal commission on a department, and commissions somebody to do a certain piece of research.

This is done because of the government-felt need to do this. We feel the Government is right in doing this and should be encouraged

to do more of it. At the same time, basic research, which does not respond to crisis but which is something on which the response to crisis must be founded, has to be done and the Government must be aware of the need to keep basic research up to a decent level. The way to do that is to see the high level accomplished elsewhere in the world and say that we must not be second to others.

This brings us back to the question of advice to Government. Clearly, in matters of expertise, Governments will need advice, which must be balanced and represent this republic in its entirety and not only central provinces, it must not just represent the natural sciences and exclude the outlying area of the social sciences. These latter are just as important and need exceptional emphasis placed upon them, because most of the research to be done in social science of a basic kind is of a kind relating to the problems in the country and for that reason it must be closely related to Government policy formulation, in the interest of sound and good government.

The Chairman: Instead of trying to draw sophisticated distinctions between pure and applied research, could we discuss a more easily made definition, between free and mission-oriented research? Even "mission-oriented" research is quite equivocal. I have noticed in your brief that you speak of all kinds of research being funded by federal departments as mission-oriented research. For me, most of the research is "free" research. Of course, it is defined and confined to a subject matter.

Most grants are given only on application by the researcher himself and within the limit of the subject matter.

In the Department of Labour we can have fundamental research, applied research, and historical research on labour problems. The researcher himself chooses his own subject of investigation. For me, it is not mission-oriented unless we define mission-oriented only by the subject matter.

If we agree that this is also free research but limited to a broad subject matter, it means that we have already within the federal structure many institutions and departments giving grants to free research.

Senator Bourget: Would we agree on that? You have given your own definition, Mr. Chairman. Would these witnesses agree with it?

Professor Mallory: I think it is substantially true that when it comes to supporting mission-oriented research within an army of scholars, they realize this is a chance "to do my thing" and learn a great deal about it or make a new breakthrough; but it tends to be intermittent when you have to create an instant community of experts and then when the problem is solved the community will dissolve, too.

That would be possible if all economists were interchangeable, but they are not. You must have a continuing opportunity for the kind of problem you encounter with employees on labour relations or on the economy.

The Chairman: If a man wants to do research on labour problems he has just to go to the Canada Council for a grant, or go to the Department of Labour. A man interested in urban research has just to go to CMHC or to the Canada Council. A man interested in psychology can go to the National Research Council or to the Defence Research Board.

Mr. Reuber: What about a man interested in economic theory or economic history?

The Chairman: I suppose he could go to the Bank of Canada right now.

Professor Salisbury: Just on that issue, how far can a person go to CMHC? What he has to present, if it has to do with research which CMHC might finance, it is a proposal, put in some considerable time in advance of the time he wants the funds, because of the question of putting such contract research into the budget for the next year.

There are relatively small amounts of free funds in departments that allocate these.

Secondly, he has to argue extremely closely the applied nature of what he wants to do, because he knows that those who will look at or review his request are the people in the departments. One of the burdens of our brief is that the department is not necessarily geared to make the best use of the kind of proposals that might come to it from the academic community.

Speaking as a sociologist-anthropologist, I would say that we favour the continuation of the present system of departmental grant funds being available. This is one of the multitude of sources that should be available.

We also favour the continuation of a central pool, and we would hope it would become

larger, though we believe the present pool is doing a very good job in the hands of the Canada Council.

The Chairman: This is where there seems to be some contradiction. While the Social Science Research Council is advocating more granting bodies, you in your own brief on page 9 say that in regard to the channeling of research funds to scholars in anthropology and sociology, it is recognized that some central organization is needed.

Professor Salisbury: That is in terms of pure research—we think the Canada Council is doing an excellent job.

The Chairman: I think the Social Science Research Council wanted more granting institutions for pure research.

Dean Dubé: The Government has an interest in research people to be formed in universities. Our problem with departments is that very often they come to us in universities and ask us to do a piece of research for them, but our interest in that piece of research is a special one. We want to develop new knowledge or new methodology, whereas they are interested in using this piece of research in policy formulation.

It is a problem, to go from the results of research to a policy formulation. We have to make sure that the people concerned really understand each other. Very often, they would think that we can produce a finished piece of research readily for policy formulation, but this is not our interest.

What I want to drive home is that in this mission-oriented research there are two aspects. There is the application, and there is the new knowledge part. In universities, we are more interested in the new knowledge part and also in forming research people.

The Chairman: But in most of these programs we have seen all these research agencies of the Government and most of these research organizations are giving their money on application; so that the researcher has the choice of his subject. They are not going to a university teacher and saying, "Well, we want you to do that piece of research and, if you agree, we will give you that money." This is not the procedure. Well, it is the procedure occasionally, but for the very big proportion of the money which is made available, the researcher is left free to select his own topic.

Dr. Hood: Mr. Chairman, on this general issue that we are discussing now, I think that there is no question that government departments and government agencies should be free to enter into the market for researchers and to seek to buy expertise.

I would think also that there would be no question that experts should be free to work on contract.

What I think we are particularly concerned with this morning is that an individual researcher should also be free, in the sense of having the opportunity to do research of his choosing, be it applied, be it pure or be it historical.

The Chairman: I don't think that there is anybody here who denies that.

Dr. Hood: Then what is the issue?

The Chairman: The issue is that in this brief by the Social Science Research Council they want to have more institutions.

Dr. Hood: May I make one more comment? I am not personally satisfied that the provision of opportunities or freedom, if you will, to the researcher to do work of his choosing is enhanced by multiplying the number of doors on which he can knock. I am not personally satisfied that that is the case.

Senator Grosart: Mr. Chairman, I agree that there is a tendency to semantically confuse the terms "free" and "basic". They are not the same. But in view of the comments that have been made, I wonder what the Social Science Research Council means on page 11 when it says that to further assist the funding of free scholar-generated research the Council would propose that it be supported directly by the federal Government. What does the word "directly" mean? Does it mean through the hundreds of agencies? Is this direct? What is direct support for "free scholar-generated research"?

The Chairman: They would receive a block grant or endowment, I suppose.

Professor Thorburn: This is right. In the past, before the Canada Council was established, the major sources for free research grants for social sciences was the Social Science Research Council.

There was very little money, but what money there was came through that source mainly from American foundations but also from bequests in Canada.

Now the Canada Council together with the added factor of inflation have reduced the significance of this particular operation of the Social Science Research Council to almost the vanishing point. What we are saying is that, if we had some funds—and we can see only one source, which is the federal Government—if we had some funds ourselves to initiate research, or to seed, as some people say, research in the initial stages, I think then we would be able to do a much better job of acting as the stimulator of research in Canada.

As it stands now, we cannot do that.

Senator Grosart: I agree entirely with this, but I am thinking of the structure. What does "direct" mean? If it comes through the Canada Council I think Professor Mallory would agree that you can hardly call this direct federal Government assistance to a university. What do you mean when you say direct from the federal government?

Professor Thorburn: There are two ways it can be done. The obvious and most direct way would be to grant to the Social Science Research Council in the same way that an award is made annually to the Canada Council. This is perhaps likely to be looked at askance, and I would be inclined to think that the indirect method, through the Canada Council of a block grant, would be more likely. We are not concerned with the modalities here but with the results. We draw to your attention the need for such money to make our own body effective.

Senator Grosart: This is a committee dealing with national science policy, and as such we have to be concerned with modalities. Again, I would carry my question one step further. Say the climate was such that your recommendations, specifically could be accepted, who is the political and of "direct"? Does the cabinet sit down and go over all these briefs and say "All right, we will fund scholar generated research in each discipline by so much"?

Perhaps I am labouring the point, but again I say we are concerned with the modality as you call it, the structure, the mechanism, because it is the mechanism that has gone wrong.

Professor Thorburn: If I may give you an answer more personal than that of the Council, I would say that the cabinet has to secure advice; the advice has got to come through

official sources; that is to say, probably through a body analogous to the present Science Council but which includes social sciences on the basis of an equality with the natural sciences; or there must be a special body, a council of social sciences and humanities, through which that advice should come. The Social Science Research Council is not such a body. It is a kind of peak organization which emanates from the learned societies. We would be pleased to tender advice to such a council or to the Government. We would not expect the Government to treat us as an official body. We are not.

Senator Grosart: But then, you see, the problem is how do you fund these things? The Macdonald Report suggests a set of three main councils, but the moment they say that, they go on and say, "No, we need some more; there is not enough".

Then the suggestion has been made that the Royal Society offered to become, in effect, a funding agency. Is the modality, then, merely to say that we will take these inter-disciplinary councils or, preferably, research councils such as yours and say, "All right, each of you gets so much of the pie"? Do we go beyond that? Does the decision-maker go beyond that and ask the councils to come back with a report which adds up to so much basic, so much applied and so much of this and so much of that?

How do we do this? You see, we have got to write a report here. Really, as I see it, we have to say to the Government that here is the total amount of funding that must be to put into science R and D—perhaps \$2 billion. And maybe there will have to be a 35 per cent increase for another. We have different per cent increase for one discipline and a 20 per cent in the briefs. But it all has to add up to adequate funding, if we are going to stay in the science race as a nation.

Having said that, we have to determine how to distribute it? Surely that is the key question here, because most of the objections and complaints about government policy we have heard are in the distribution area. How do you distribute it?

Dr. Hare: May I suggest, just for discussion, this structure? A minister for science or for science policy, responsible in the cabinet for making recommendations on specific points; a council for scientific policy responsible to him for advice on precisely this allocation as between the different disciplines and

different types of bodies. This is roughly what happens in the United Kingdom. I was a member of one of these bodies, and it worked. The only trouble was that the politics of it always got away from us. There were certain vested interests, such as agriculture and medicine, for instance, that did not like it and tried to get outside it. But this is how it worked, and it did work.

Dean Dubé: I know this has been written in the brief, Mr. Chairman, but I would think that the way to distribute this money to the Social Science Research Council would be through the Canada Council. This is my personal opinion now, but you must remember that this was written before the Macdonald Report.

Senator Grosart: This is opposite to the Macdonald Report.

Dean Dubé: This was written before the Macdonald Report was produced, and there has been a lot of discussion since then. Again this is my own personal opinion. I think that the Canada Council should be the body accountable for the money that goes to fundamental research.

The Chairman: You are not then accepting the Macdonald recommendations that the Canada Council should be limited from now on to the arts?

Senator Belisle: Mr. Chairman, this gentleman on the right has been waving his hand for quite some time. I think he wants to say something.

Professor Salisbury: I wanted to point out on the lower level that the constitutional changes that Dean Dubé is talking about are of considerable significance. Up until last year or so the Social Science Research Council has been more representative of universities than disciplines. It is only in the last three or four years that the Social Science Council has developed the form of organization that our brief mentions in relation to the Canada Council. In the last four years it has become what I might call the parliament of social scientists. Only now has the structure got to the stage where the Social Science Research Council can be responsible through learned societies to a constituency of all the research workers of Canada, whether in or out of a university. I would submit that the Canada Council is now part of this structure, providing its umbrella and can to a great extent take recommendations from the Social

Science Research Council and from the learned societies. There is a lot of discussion within the Canada Council and academic reviewing panels and so on but now the SSRC is an agency that is responsible directly to the scholarly community and not to universities. Here I would speak against the Macdonald Report, in its call for breaking up the Canada Council and I think all representatives here have been talking very much in the same way. The Canada Council has done an excellent task in the distribution of funds but the Social Science Research Council now is responsible to the disciplines at large. Discussion of matters of concern goes first through its infrastructural committees, and through the learned societies with their own sub-committees. For example, in the CSAA we have a sub-committee for liaison with the DBS regarding the census, and other associations also have this sort of structure. Thus there is an infrastructure for the discussion of disciplinary problems in the distribution of free research money. This includes both the Canada Council and the Social Science Research Council.

Senator Grosart: I hope that you will not mind me, as a senator, making this comment. I notice that in your brief you refer to the new setup in the Social Science Research Council as "*a reformed social science research council.*"

The Chairman: Is this the view of all learned societies engaged in social science research that the Council now as reconstituted can become the umbrella, so to speak, of all social sciences and can become the spokesman on behalf of all the learned societies in these fields when it comes to consulting or advising the government at the private level?

Senator Grosart: Mr. Chairman, that is not what the Canadian Sociology and Anthropology Association suggests. At page 5 of the brief they say quite definitely:

In our opinion, less attention should be paid to creating a monolithic structure for all social science research on behalf of the government.

The Chairman: That would not be a government agency at all.

Senator Grosart: But it would be a monolithic structure which the Social Science Research Council recommends creating although not a government structure.

Professor Salisbury: Creating a government structure which we feel, and I am sure my

colleagues from what they said would agree with me, which would provide a channel upwards through which advice could be given and a channel downward through which funds could be distributed, or through which discussions could be held regarding their distribution among the disciplines.

The Chairman: You would like to have a monopoly position on the demand side but competition among the government agencies on the supply side.

Professor Salisbury: This is in relation to the pure research which in turn relates to free scholarly demand in research—I have forgotten the exact wording—in the terms of mission-oriented research. Quite clearly it means a different structure in which government departments have to bid in the market as Professor Budd suggested, or at least operate independently.

Dr. Hood: May I have a word at this point? Professor Salisbury, so far as I am concerned, has spoken for himself.

The Chairman: And you would like to do the same?

Dr. Hood: I would like the opportunity to do the same. The Social Science Research Council is a federation, and in no federation that I am aware of are the constituent members unable to speak for themselves on certain matters and at appropriate times. I am sure the Social Science Research Council would expect that its constituent societies would feel that these societies could represent their own interests themselves.

Dean Dubé: We would encourage it.

Dr. Hood: May I add further that I do not think that any of these things is either black or white. I am sure there would be cases where it would be more appropriate for the Social Science Research Council to speak and the rest to keep quiet, and in other situations the reverse would be the case. This would not necessarily mean a full reflection of the variety of views on the matter in question.

Now, while I have the floor, I want to deal with the question of channelling funds to the Social Science Research Council from the Canada Council directly to the programs. Again I do not think this is a black and white situation, and I am not at all sure you are speaking to those who have the best expertise on how to administer a program of this kind. My own feeling would be that by and large, and I may say that I am speaking of what I

deem to be quantities of money, I would have thought that the Canada Council would deal directly rather than through the Social Science Research Council. On many of the Canada Council programs the social scientist in one form or another is to be called on to do the appraising. If he is to do it efficiently, it would be a burden on the social scientist if he had to do it through another layer. On the other hand, there are specific kinds of programs where I think the help of the Social Science Research Council would be most desirable. I do not want to take a doctrinaire position, but by and large I think the Social Science Research Council would work directly as it has been doing.

Senator Grosart: What would you think of the principle of the Canada Council responding directly to a request on the part of an individual engaged on a program in a university, without discussing it with the university?

Dr. Hood: I do not quite understand what you mean.

Senator Grosart: The situation where a funding agency would deal with a researcher directly without consulting the university as such.

Senator Belisle: This would be very dangerous.

Senator Grosart: It is being done all the time.

Dr. Hood: I am not quite sure of what you have in mind.

Senator Grosart: The National Research Council and the Canada Council can respond directly to a request for funding from an individual in a university without in any way consulting the management, if I may use that term, of the university. I am asking you if you agree with that approach.

Dr. Hood: Let me state what I understand to be the case. I understand that when an individual staff member of a university makes an application to the Canada Council for a grant, stipulating, for example, that he is going to be on leave of absence for the next year, the Canada Council requires—and I stand to be corrected if I am wrong, but my understanding is that the Canada Council requires information from the university as to whether this application is approved by the officials immediately superior to the applicant.

Senator Grosart: This may be so in the case of the Canada Council, but we have had a great deal of evidence, taking the broad picture of fund granting federal agencies, that this is not so. We have had very serious complaints in briefs before us on this ground.

Dr. Hood: The social sciences do not deal with NRC. I would say we have found the arrangements through which we deal...

The Chairman: Except those in anthropology.

Dr. Salisbury: The universities are all in favour of getting research grants, but it is only recently that most universities have become aware of the fact that in order to administer them it entails something of the order of 35 per cent in costs and overhead, and they have been paid by the universities. As funding of research has increased, so the 35 per cent has increased. That is a really serious problem in which the universities want to be consulted, and I do not know, in my own case, whether any university has refused to accept a research grant because the overhead is not paid, but, clearly, overhead is the main problem.

Senator Belisle: I want to qualify the reason I said a while ago that it would be dangerous. To my knowledge there has been some direct contact between the Council and the individual but with the full knowledge of the university board or administration. But, if they were to start to deal directly, without authority, I think this would be dangerous.

Dean Dubé: The application for funds has to be signed by the departmental chairman, and he has to give his approval.

Senator Kinnear: Mr. Chairman, I have been listening to funding for so long, in so many briefs, for so many days, that I wonder what would happen if you got exactly what you wanted. In the brief of the Canadian Economic Association you make a very drastic statement, I think, when you say in your conclusion:

more and better economic (basic or applied) research in economics in Canada (in government, business or the universities) depends uniquely on first building up a stock of first-rate Canadian and foreign-trained economists, to man and develop the graduate schools,

and so on.

Supposing you had all the money you wanted, are you certain you could get the desired

capable people you want? That follows through in the case of the brief of the Canadian Sociology and Anthropology Association. On page 5 you state:

Much more attention should be paid to providing top grade staff and consultants, and so on.

The Economic Association continues:

The present stock is far too small and too weak.

Mr. Reuber: I think there is no question that the stock of capital, in the sense of the stock of manpower of first quality in this country, in all the social sciences, and certainly in economics, is too small. The question you asked is whether it could be increased if we had enough money. I would say the answer is, "Yes."

Senator Kinnear: I would hate to think we are not producing good researchers and good scientists, and that they are weak ones.

Mr. Reuber: We are not saying that, but we are saying that there is too little of it.

Senator Kinnear: I would agree with that.

Mr. Reuber: If Canadian universities were reinforced in the way we are suggesting, with funds for salaries, for stipends and research facilities, and so on, there is no intrinsic reason why they would not come to Canada.

Senator Kinnear: What is the difference in salaries between Canadian and American researchers, percentage-wise?

Mr. Reuber: I do not know, but I can tell you that some of the first-class economists in the United States would get of the order of \$35,000 a year basic salary. I do not think there is anybody in Canada who gets anywhere near that. In addition to that, he could count on substantial stipends during the summer as part of his research grant. In addition to that, he could count on a class of graduate students that were funded very effectively. There is a tremendous difference, if we are talking about the very top of the group. If we are talking about the rest of the community, the differences, are not that much.

An important point we make in this brief is that we really have to reach a bit to aim at the first class and to deal in this international market for excellence, which has been emphasized earlier by my colleague Dr. Hood. I am not saying, for one moment, that we do not have excellent people in this country. I

am saying we are too thin, we are not enough, and we have to have more resources pumped in. Then, if we do, there is no question that we can, in fact, immeasurably increase our stock of first-class talent. Indeed, it has already begun to happen. In the last five years there is no question but that more money has gone into research facilities in the universities and the like, and all you have to do is look around any university to discover the tremendous improvement that has occurred; but there is yet more to be done.

Professor Salisbury: An important factor is the five-year time lag with programs which started in trying to produce professional personnel in 1962 and 1963, and they are now only beginning to turn out the personnel. So, for example, in the sociology and anthropology disciplines there were probably 30 new appointments in Canadian universities for September of this year. The total number of Ph.D.'s, because most of the programs only started in 1962, '63 and '64, is of the order of five in the whole of Canada. That is going to increase quite dramatically in the next five years, but just because we are five years behind where the demand occurs that means that there is going to be this tremendous need. It is a problem of filling in the gap somehow.

Dean Dubé: But as Professor Reuber pointed out, it is not only a matter of salaries, but it is also a matter of building areas of excellence. It has to be done in a very selective way, I would say, and the universities themselves have to be involved. I think you have to look at the overall pattern, and not only this matter of salaries of individuals.

The Chairman: But you are, at the bottom of page 6, referring to these specialized research centres. I understand there will be few spread across Canada, but among those that might be created, would you expect that there should be one within the federal Government?

Professor Thorburn: The thought was that, given the facts of life in Canada, it would be necessary that such facilities be available to scholars in different regions. There might therefore be four or five such centres simply so that scholars could use them, and to respond to the political facts of life in Canada. I think the federal Government will have to be turned to as the source of funding these, but the provincial governments are under great pressure to support this.

The Chairman: Rather than being located within a university or four or five universities, I was wondering whether you would also favour the establishment of such a centre within the federal Government, so as to have some kind of parallel research organization in the social sciences that we have for the physical sciences and the life sciences.

Professor Thorburn: What we were thinking of here is something that is by the federal Government, but not part of the federal Government structure. It would be set up on a basis of independence...

The Chairman: I recognize that, but if you had four or five universities of this type across the country, would you accept in addition one that would be within the federal Government?

Dr. Reuber: I think in our brief we do come out with that. We do endorse that idea, if you are talking in terms of an institute of advanced studies. I think that is required very much in the social sciences in this country. We are never going to have a national university like Australia, because of our different historical background, but I do think we have a very strong interest in having one place in the country that is really a magnet for the best scholars in the world; where people from our universities can go for their leave; where our Ph.D. students can go for intensive research. There is a variety of things that could be done.

This was mentioned in the Speech from the Throne. As far as I am concerned this is one of the most interesting ideas that has come along. It has a tremendous potential for lifting the whole area of social science, and providing an infusion of really major talent, and providing the facilities and environment that is required.

The Chairman: Would you go a step further. We have been told by the scientific community interested in the physical sciences and the life sciences that it was absolutely opposed to the separation of the in-house research function of the N.R.C. and the granting function of the N.R.C. So that if you have a centre of excellence within the federal Government doing research in the field of social science, would you then tend to say: "Well, let us ask the Canada Council to give up this responsibility and give this other responsibility for funding social science research at the universities to this new institution?"

Dr. Reuber: This new institution would be funded by the federal Government, but it would not be a department of the federal Government. It would be autonomous.

Secondly, I would argue that this should be an institution to which people can go to do research. It should not be primarily a granting agency. That function should be retained within the jurisdiction of the Canada Council.

The Chairman: Why are you so strong on this with respect to the social sciences, while the rest of the scientific community in the physical sciences is adamant in its view that the N.R.C. should go on doing research and also be the granting body.

Dr. Reuber: I cannot speak for them. I do not know what their views are.

The Chairman: But what is the reason for the difference?

Dr. Hood: The focus is rather different, Mr. Chairman. An institute of advanced studies, as we conceive it, is not in any sense a grant-giving body, whereas the National Research Council has that function. A positive argument for the scheme that we have put forward is, as Professor Reuber has said, that it becomes a centre to which one can attract scholars of world-wide repute, be they now resident in Canada or not. It is a centre to which they can go for a period of time and devote themselves to research, rather than teaching; a place to which Canadian scholars will go for their Sabbatical years. It is a place where younger researchers will go for a short time, and a place where you would have a very special opportunity for the master-apprentice relationship in the game of scholarship. It will be something quite different from the university, although it will be like a university. It will have no teaching function, but an instruction function in this master-apprentice relationship between the very experienced and the younger scholar. It will not be a grant-giving body at all.

Senator Grosart: Is it your suggestion that this national institute for advanced studies be limited to the social sciences?

Dr. Reuber: This is within our thinking. There may be, of course, scope for setting up other types, but if you establish one institution with too many wings then it tends to be all things to all people. I think it would have more thrust if it has a focal point in certain disciplines.

I think such an institution has another role to play in the social sciences. It could become

a place where people such as senior civil servants could go for a year and recover, if you like, after which they can return to their jobs with new views. There are a number of things of this kind that can be done, all of which are extremely useful, and these are the things that I, personally, would like advanced.

The Chairman: There is also the suggestion that we should have a kind of research institute on international development, and another research institute on transportation. If this institute...

Senator Grosart: And one on ballet.

The Chairman: That is not within our terms of reference. If these institutes were created, how do you see their relationship to this centre of excellence?

Dr. Reuber: I think you can have institutes which are geared to particular problems, but what we are talking about here is an institute that is really of a much broader gauge. There is a danger in having too many institutes, and I would hope that one really good institute would obviate the need for all this periphery of smaller and very confined types of institutes. If you had one really first-class operation then some of the things that these other groups are interested in might, in fact, be accomplished as part of this bigger program.

In the case of an international development centre, I think there may be a case for a separate function there because it has its own very definite outlook and is, in a sense, concerned with a very specific problem. But, there is a great deal to be said for having one first-class operation of this kind. If you had a first-class operation of this kind then I think the demands for some of these others would not amount to much.

Professor Thorburn: I think we should be clear on what we are talking about here when we talk about a centre for advanced studies. It could take many different forms. We have already the National Library. I think the discussion started when we referred to the study which the Social Science Research Council has been conducting into the idea of a data bank which, when examined, was realized would be better conceived as a social science research agency. The main function of this would be to provide a centre to which scholars could go in order to do particular kinds of research. We were not talking about the National Library. That is something else. We are talking about a centre which would, for

example, make possible the tapping of data sources so that we could have access to data which is stored now in different places, so that we would know what was there and what was evolved.

We would also have it produced in a way compatible with one type of data. This is the major thrust of it. There is the other dimension of survey research which, if it is to be done, has to be done properly, and it is a complex matter. We thought this might be built into the same kind of structure because it is so often related to data stored tapes and cards and that sort of thing. Therefore we thought there should be centres, or if you like a centre, where survey research instructions and survey research materials could be stored, all these things being brought together to make this kind of relatively sophisticated complicated type of operation efficient and up to date. This is really what we had in mind when proposing these agencies. I would think it appropriate if we were to table the report, which is a very preliminary one—we are having a conference on the matter in the autumn—with the committee so that they could see exactly what we have in mind when speaking of this kind of agency.

Mr. Reuber: What we have in mind is not quite what has just been described. We have in mind more a centre of advanced studies.

Dean Dubé: Could the two be combined?

The Chairman: You refer to specialized research centres providing research opportunities and retraining programs. Surely this goes far beyond the organization of a data bank or instructions in new survey techniques.

Professor Thorburn: Yes. What we had in mind was one thing.

Professor Salisbury: I think it is worth while stressing the difference between what Professor Thorburn is doing, because I am not sure whether this is what Mr. Reuber has in mind in referring to a centre for advanced studies. This is an organization to which people come for one year; it does not have specialized equipment and permanent staff, such as the NRC requires for its research, with large scale equipment, making it absolutely essential to have a centralized facility conducting research. A research institute or centre for advanced studies is best organized without a permanent staff, or a permanent staff only as housekeeping staff. The research workers are people on sabbatical, top level

men coming for one year from several disciplines, who get as much from talking to people from other disciplines as from conducting their own specific research and receiving research assistance to collect data. These are two different functions.

The Chairman: They are not incompatible though.

Professor Salisbury: They are not incompatible. There are indeed two structures. One is the localized research centre with specialized equipment; the other is a centre to which people come and talk, the "think" men if you like, which is of a very different order from the specialized research organization.

Senator Grosart: I should like to come back to the question of the structure. Perhaps I could have some comment on a statement in the brief submitted by the Social Science Research Council, which is apparently dissatisfied with the present structure. On page 11 the council views

...with some alarm the possible influence of the Science Council of Canada in areas of the social sciences and even the humanities.

On page 12 the council quotes, with what I take to be satisfaction, a statement that the Canada Council as "essentially a bureaucratic organization", which I take to be a criticism.

Professor Thorburn: No, that is a statement by Mr. Milligan himself.

Senator Grosart: I say, you quote it with apparent satisfaction. What is the objection to it being bureaucratic, if that is not a criticism?

Professor Thorburn: There is no criticism. This is the way it performs.

The Chairman: What you mean, I think, is that the Canada Council does not have responsibility to advise the Government on science policy.

Professor Thorburn: Yes.

The Chairman: As opposed to the Science Council, which has a responsibility to advise the Government on science policy.

Senator Grosart: I am glad you have explained it to me, because it was not clear. I should be inclined to think the Canada Council has much more power than the mere power to advise; it has the power to make government policy.

The Chairman: In the allocation of funds.

Senator Grosart: If you are allocating funds you are making government policy.

The Chairman: But this is a quite different function from advising as the Science Council is doing. I was glad the new president made this a little clearer this morning, because from your brief we get the impression that you take a kind of negative approach to all this, in the sense that you are glad to see the Canada Council as it is now and you view with alarm the Science Council being more and more involved through the front or back door with the social sciences.

Dean Dubé: I think we are at a different stage in our thinking process.

The Chairman: If we maintain the Science Council as it is and do not give any additional responsibility to the Canada Council, it leaves a vacuum, which to a large extent explains to my mind the weakness of our effort at the federal level in the field of social sciences. I would therefore ask if you favour an extension of the Science Council to include specific representation from the social sciences.

Dean Dubé: I said this in my opening remarks.

The Chairman: But you were speaking personally at that time.

Dean Dubé: No, at that stage I was speaking for the council.

Professor Mallory: Perhaps I could elaborate on that. It is quite clear that it needs to be advised by people interested in both the pure and applied natural sciences. But it is equally clear to us that it needs to be advised by people in the humanities and social sciences. A token report of humanists or social scientists to a body which then tenders advice may well be regarded in the end as absurd because our own representations were insufficient in this group in some way, whereas in this present situation it would be important, if there were adequate social science advice from the scholarly community in the non-natural science field, that it be sufficient and adequate to that any recommendation made to government was one likely in the nature of things adequately to reflect what we think is a good policy for supporting the humanities and social sciences. To decrease the representation of this kind and the way in which these people select it are things that concern us greatly. Our initial

negative reaction to it was at the stage when we felt the Science Council had in a sense unilaterally enlarged its mandate, and thus there was the vacuum of which you speak. Somehow the vacuum should be filled, and at that stage we were not clear in our minds whether there was any way of clearly changing the structure of the Science Council in the short run which might to us be advantageous.

The Chairman: They can now, under their statute, go into social science and have members on the council from the social sciences. There is no need there for any change in the legislation. It has simply not been done up to now and I am glad to see that you favour a change in representation on the Science Council.

I think it would be according to the importance of the disciplines, and of course there should not be any kind of mathematical formula. If the social sciences are to be represented on that council they should be properly represented, both in terms of quantity and quality.

Senator Grosart: It seems to me that we are looking first for a definition of science and science policy. I believe I said on an earlier occasion that the official definition of R and D by the National Science Foundation in the United States, which is, in effect, the official United States Government definition—is one from which the social sciences and psychology are specifically excluded. Our first problem is what is in “science”? It seems to me that we are discussing, and perhaps confusing, three different types of structure. One, the structure of the input of advice and influence of the science community into a national science policy; two, the structure for national science policy decision-making by a group of politicians, large or small; and third, the structure for the implementation of national science policy by funding and other methods.

We should keep our discussion clear as to which one we are talking about and then we might get closer together regarding some of these problems.

The Chairman: I think you have missed a link there as well. It would be a good thing to have a discussion along those lines for a moment. It seems to me that the science community itself, as we discussed last week with some of the other groups, should have some kind of umbrella or organization to make representations to the Government.

Senator Grosart: In other words, the Republic of Science might have a parliament of science

The Chairman: They should have at least a voice there. The spokesmen should be selected by the science community itself, and speak on its behalf. There is the second advising phase, in which the Government appoints people from the scientific community to advise it directly, such as the Science Council. These people are not there necessarily to represent a scientific community, but to advise the Government on what it should do. And, of course, political decisions have to be taken and, as you say, the channels for allocating the funds have to be established.

I believe Professor Jones, who represents the sociologists, has been trying to attract my attention for a number of minutes.

Professor Frank E. Jones (Canadian Sociology and Anthropology Association): I should like to make a comment on this question of structure as it perhaps pertains more to the influence of the social scientist. I should like to enunciate a principle which might well be paid attention to, whatever the functions of the different structures that Senator Grosart mentioned. This is the principle which would maximize autonomy for social science research within the limits of the Government financing and budgeting. I say this because I believe there is quite often social science research which is quite sensitive, and at times it is hard to conceive of it being financed by a body which did not even have relative autonomy from the Government of the day, even though its money might have principally come from that Government. For example, there is a lot of research on political preferences. I think that is one of the reasons that the Canadian Sociology and Anthropology Association prefers to see the Canada Council continue to play an important role in the granting of research funds. When I say that we prefer to see the Canada Council continue in this way, this is not to say that we want to see it persist in its present form.

We have presented a brief to the Canada Council which calls for radical re-structuring to give greater influence to social scientists and to change the balance somewhat between social scientists and the lay community. I hope, in some small way, we might be influencing some of the thinking of the Canada Council in that regard.

The Chairman: Can we get the benefits of your views as well?

Professor Jones: On what we have suggested?

The Chairman: Yes. Can we get a copy of that memorandum?

Professor Jones: Yes, I will leave one with you, Mr. Chairman. I think this question of relative economy is very important.

The Chairman: Last week we were told that one of the reasons why the humanists wanted to remain with the Canada Council was that they wanted to be more or less hidden and protected by the artists. Is this part of your justification also, to remain with the Canada Council?

Senator Grosart: They want to get in the club.

Professor Jones: I do not think so. I think the main reason, as I would see it, is that the Canada Council enjoys a certain autonomy in the way it distributes funds.

The Chairman: NRC enjoys a lot of autonomy.

Professor Jones: That is quite a different point. I should like to discuss later on the differences between research done by the social scientists and research done by the natural scientists.

The Chairman: You mean that a federal structure of any kind, provided it is linked with the arts, orchestras and ballet, will remain freer from government intervention than if it deals only with the social sciences.

Professor Jones: You see what I am suggesting. We are proposing some change in the structure of the Canada Council which will make it more responsive to the social science community and humanities, and separate it somewhat and provide a kind of umbrella which does not necessitate a division. We see advantages in this, because I do think the council has considerable autonomy in the way it decides upon funding. It is not responsive to the political pressures of the day, as some other types of organizations might be.

I am suggesting that whatever kind of structure is recommended or suggested, that that principle is very important because of the scientific nature of social science.

The Chairman: I suggest that the CBC has quite effectively resisted political pressure, although it was in a field which was as hot as the social sciences.

Professor D. V. Verney, President, Canadian Political Science Association: As has been indicated, where the disbursement of funds is concerned and where political influence is concerned, we are in a pretty delicate area.

We are beginning to ask another question—and this is why the Macdonald Report interested us—as to what is going to happen in the next ten years. Shortly we will have as many graduate students as we have undergraduates—40,000. How are we going to teach them and establish research centres.

An unanswered question is, can the Canada Council move from the present level to a new level of operation or is the Macdonald Committee assured that something new is to be done because of the difference in scholars.

We are aware of that difference and see it is necessary, but on the other hand we do not want to abandon the structure which has worked so well.

The Chairman: I am a little confused about this this morning, because my colleagues will remember that last week, when the Royal Society was before us, a sociologist from the Department of Sociology in Toronto, told us that, in so far as they could ascertain, most of the social scientists favoured a separation, and creation of a special council for the social sciences.

To complete the record, I must say that a professor representing humanities at that meeting strongly favoured remaining with the Canada Council. This morning we are told a different story so far as the social sciences are concerned.

Professor Thorburn: There is a difference of opinion about it.

The Chairman: There seems to be remarkable unanimity here.

Professor Thorburn: In the social science community we have to admit there is a difference of opinion, stemming from the different perspectives. If we were to start all over again, and if the Canada Council did not exist, very few would consider structuring the Canada Council as it is now structured. We would not have thought of the fine arts being put under the same roof as social sciences and humanities, although Professor Jones has given a good reason why that may be a good thing. But now we have the Canada Council in existence and doing a very good job.

The criticism of the Canada Council that you find among social scientists, one you probe it, you find that criticism relates to the Canada Council in the way it used to be five or more years ago.

The Chairman: When they did not have any money?

Professor Thorburn: Yes, when they did not have any money, but now when they are doing a good job and there is a good deal of confidence in the way in which they are considering applications and making sure that merit is the rule and the criterion of judgment, the position is greatly changed. The Canada Council now is working in one part like looking after arts and in another part looking after social sciences and humanities, as if it were two bodies.

There is little to be gained by cutting it into two, if it is already functioning *de facto* in two separate areas without any obvious lack of efficiency and, indeed, with conspicuous success.

The Chairman: I suppose that if the recommendations which have been made by your group (the Social Science Research Council) to the Canada Council are accepted, we will have even more than two *de facto* councils.

Professor Thorburn: What we are suggesting in our brief is the fact of the extended principle that we have already seemed to recognize. At one point they did not provide for any formal influence with the different disciplines that separate, say, the arts on the one hand and the humanities and social sciences on the other—eventually they establish a form of structure, an academic panel. In part of our brief, we have carried that principle further.

Secondly, there is the suggestion that this principle should have been applied even to the composition of the Council itself.

Professor Salisbury: It is the composition of the Council itself and the original establishment of the Council with an endowment that gave it its independent nature, the Council being laymen with a few academics on it. This provided for dealing with such things as political pressure. I think we would all want to see this Council retained, provided that in technical matters, such as reviewing grant applications, an expert in one field is not asked to talk about facilities in another research field such as mathematical analysis.

To the extent that there is a subdivision of specialties and skills, the Canada Council has been increasingly recognizing this, with academic panels all the way down.

All we are asking is that that particular aspect of it be increased and that greater representation be given at the top level. That structure is a very good one.

Dean Dubé: To follow that, we have to come back to the question by Senator Grosart. The Canada Council was established at the time when there was no science council. There is a science council now, which is different from the one that we recognize. It may well be that we have to look at the relation between the Canada Council and the Science Council. I think there has to be consultation between the two. One is a funding agency and the other one is a political agency.

The Chairman: It is an advisory agency.

Dean Dubé: An advisory agency. The Science Council covers both science and arts, there may be something a little irrational there. We think this should not be open to debate at this time, because of other considerations.

Senator Grosart: Are we not really saying that, because of the nature of the disciplines that came originally under the Canada Council, that the federal Government stumbled on a particular ad hoc method of funding free research—because this was an area where the funding of free research seemed to be simple. It was not an area where you could tie funding specifically to missions or projects. I am speaking now of the arts generally. Part of that ad hoc mechanism was to free it more than most agencies from political control.

Therefore, the science community generally asks for other mechanisms of the same sort.

Rather than saying we should keep the Canada Council, or restructure it, I wonder whether the social science community is not saying: "What we are really interested in is in extending this principle of a high degree of autonomy, free from political day-to-day influence, plus the very fine consulting mechanism that the Canada Council has set up". Is that not it?

The Chairman: To put it in other words, you are more interested, I understand, in preserving the kind of mechanism which has been developed than in setting up something new?

Mr. Reuber: That is right.

Professor Jones: In part, because we know that such people have some influence and that perhaps where this concerns overall policy it may relate very much to the kind of influence, in the question of financing social science. What strikes me about some of the discussion this morning is that, in talking about the bases of establishing priorities, the discussion went on for some time on the question of basic versus applied or free versus mission. I don't think there is really a great deal of distinction between those pairs of ideas, because I think those run on a continuum. At one end there is straight descriptive research and at the other end there is theoretical research.

In the fields of social science and anthropology, certainly, we find that people are doing what might look like mission research but is nevertheless pretty good theory. That could be documented by reference to British social work. I can also think of work I have done and others have done. The facts that some bodies want to use do at the same time generate theory.

My feeling would be that the critical alternative, in talking about priorities, is really the question of the basic people-oriented-research versus the more natural science-technological research. It is that particular balance which is of the greater concern. It is true that, when we talk about priorities, we get into the area of great generalities and there is no way of easily deciding these because one can argue that certain kinds of technological expenditures are really for the benefit of the people. Certainly, in that respect you can consider the debate going on in the United States about missile research versus poverty research and so on.

I think there are times when the priorities stand out a little more distinctly.

One of the critical issues is certainly that of priorities. Although I would certainly like to support statements that some of my other colleagues have made to the effect that one cannot really establish any kind of eternal priorities, one must determine these in relation to changing times, and we live in a society where the speed of change increases and accelerates all the time so that one should not think of eternal priorities.

Senator Grosart: Surely the continuum between what you call "object" research and "people" research is every bit as great as the continuum between basic and applied science.

Why make a distinction in one place and not in the other?

Professor Jones: I could think of them as a continuum in that sense, but it would be a lot easier to demonstrate various kinds of projects done quite validly in either natural sciences or engineering, which have very remote application to individuals. Very indirect.

Senator Grosart: That would not be in line with the evidence we have had from the object research people, because every single brief, so far as I can remember, made a great issue of the fact that it was doing people research. Because that is how you get funds, you see.

Professor Jones: Well, whether it is explicitly or implicitly, it is ultimately. I think ours is more direct.

Professor Thorburn: Mr. Chairman, I wonder if I could refer to Senator Grosart's distinction between the three levels in the structure for purposes of clarity?

Senator Grosart: May I just say that I did not make them. The science community made them. I have learned those semantic distinctions since becoming a member of this committee.

Professor Thorburn: The emphasis in this is related to the matter of structure. Perhaps I could repeat what I conceive, or what the Council conceives, to be the designations of these three levels so far as we are concerned.

You refer first of all to the function of giving advice to the Government in the sense of private bodies going forward to tender advice to a government—the sort of thing Senator Lamontagne referred to the trade unions or chambers of commerce doing.

Senator Grosart: It goes beyond advice. It is influence. That is an important distinction that I think the science community may have missed.

Professor Thorburn: That function has been carried out by the learned societies and by the Social Science Research Council as a kind of peak organization of those in the social sciences.

Now, the discussion within the government community...

The Chairman: I don't think it has been done very much in the past.

Professor Thorburn: You are correct. We think that things are changing now, however.

The Chairman: For three years I was responsible to Parliament for the Canada Council and I don't remember receiving any kind of representations.

Professor Thorburn: This is correct. It is clear now that the learned societies are formulating themselves as active bodies that do more than convene meetings and publish journals, however.

The Chairman: It would have been most useful then.

Professor Thorburn: You will perhaps receive more than you want in the future. This function will be carried out by the SSRC and by the learned societies.

The second function is that of a discussion of priorities and policies within the government circle. It seems to me that one essential role here has to be made by the Science Council or by another council that you would create to involve the social sciences and humanities. Our preference is that the Science Council be enlarged so that the social sciences and humanities are equal in weight or numbers to the natural sciences. Debate will therefore take place within that Council and issues will be thrashed out so that the cabinet can discuss them.

The Chairman: Before going on, then, will you come back to your first stage? As you know, we have had for a few years a national conference on the arts, which gathers every year. It is comprised of artists in all fields who try to arrive at a certain kind of consensus. Do you think it would be possible to have a kind of similar national conference on science where all the sciences, all the disciplines, would occasionally meet, not to discuss their own limited needs or their own limited professional problems, but to discuss their place in society and how they would like the national science policy of their country to be conducted?

Professor Thorburn: Well, sir, this suggestion comes as a new one to me. It strikes me that it would be a very interesting jamboree exercise every year, but I would think that it would be so large, so discursive and, as a result, so incoherent, that to deduce policy from such a large conglomeration would be difficult. A smaller body with an agenda, with calculated representation, directing its attention to a particular policy at a particular time

would be more successful. That is why the idea of a science council is good.

The Chairman: This is quite apart from the Science Council. The Science Council is advising the Government. It is a government body. I am speaking now of a private institution which would debate the problems of national science policy in Canada; it would do very much what the national conference on the arts does in respect of the arts.

Dean Dubé: I think we are not ripe yet, Mr. Chairman, to do that. I think the Science Council should do its work for some years, and, when the time comes, we can organize such a conference.

But we still have to have some agreement between the social sciences and the natural sciences, and this can be obtained only within the Science Council to start with. After that we could organize a conference.

Mr. Reuber: Mr. Chairman, I would add that one of the important missing ingredients in all of this is just a lack of information. We just don't have sufficient information. The Macdonald Commission tried valiantly to get round that, but I gather with indifferent success. I don't have any objection to your proposal of this kind of conference, periodically, but such conferences can amount to much only if you have in fact somebody who writes papers and you have something to talk about in a very concrete way. In a sense, it is a prerequisite that you have a considerable amount of homework done by the Science Council or by somebody in order to generate information so that we have in this country some basis for making these decisions.

There is a lot of discussion on science policy that has the character of a sort of one man's opinion and word against that of another. We are very, very deficient in hard numbers, for example.

The Chairman: This has been one of the themes discussed before this committee. I am sorry Senator Cameron is not here because he usually inquires about the inventory of our science effort. I understand that our inventory in the field of the physical and life sciences is very incomplete, but in the field of our social sciences we have no inventory at all. We have discussed this with DBS and similar organizations and apparently this presents some difficulties and nothing has been done as yet that I know of. We are told by some people from industry that there is more research in the social sciences in industry than in universities. I question that, but I do not know.

Professor Thorburn: Mr. Chairman, just to complete my reply to Senator Grosart's question, the third function he referred to was carrying out government policy. We would see it as being carried out by a body such as the Canada Council which is the funding body. As we perceive these three functions, we have three distinct bodies in mind, to perform these functions. For example, one would not turn to the Canada Council for advice and one would not expect disinterested advice from the Social Science Research Council on an overall basis while they could advise about the social sciences alone on a voluntary basis.

The Chairman: Thank you very much, gentlemen. It is now a quarter to one and the time to adjourn. I am sure the discussion could go on for a long time with much enlightenment for the members of the committee. I would invite those of you who can do so to join us again this afternoon and if you so wish to take part in our discussion which we will have with our guests who will be around this table at that time.

Thank you very much.

The committee adjourned.

APPENDIX 119

BRIEF TO THE SPECIAL COMMITTEE ON SCIENCE POLICY

THE SENATE

by F. Kenneth Hare, at the request
of the Canadian Association of Geographers

BRIEF TO THE SPECIAL COMMITTEE ON SCIENCE POLICYTHE SENATE

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Preface

The Canadian Association of Geographers is the main professional organization of geographers in this country. The Association is briefly described, as is the synthesizing discipline it represents. The case is made that geography is particularly relevant to science policy-making in Canada, and that its skills have an important bearing on national problems. Geographers are dissatisfied with present avenues whereby they can make their views known. It is suggested that the Advisory Committee on Geographical Research, perhaps with different departmental affiliation, be considered as a suitable vehicle for conveying the profession's views to the government.

The Association and the Profession

The Canadian Association of Geographers was founded in 1951, and has become the national association of those who make geography and its related disciplines their profession. Its membership is drawn from many walks of life, but is strongest in the universities, the civil services, the teaching profession and in the business community.

The Association holds annual meetings, often in association with the other learned societies, and has several regional divisions which also meet for the presentation of papers. It publishes quarterly The Canadian Geographer, through the University of Toronto Press.

The 1968 list included 446 full members, 87 associate members, and 353 student members. The high proportion of student members reflects the recent rapid growth of university geography departments, and of job opportunities for young geographers. In session 1968-69 there were 1588 known honours registrants (including the baccalauréat) and 2962 geography majors in the country's universities, a trebling in two years. There were also 583 candidates in residence for higher degrees, including 128 for the doctorate. In 1967-68 86 masters and 10 doctor degrees were awarded.

Apart from the large number of geographers who work as school, college and university teachers, the profession's primary activity is in the civil services and business. Areas of work in which the profession has many members include urban and regional planning, local government, resource survey and development, conservation, transportation (including the President of the St. Lawrence Seaway Authority), surveys, mapping, and territorial exploration.

The Discipline and its Capacities

Traditionally, academic geography has been concerned with the colonization of the earth by human societies. It is a social science to the extent that it deals with those societies, a natural science to the extent that it is concerned with their external environment, physical and biotic. Its methods are increasingly those of the systems field, and are increasingly quantitative. They deal above all with space relations, as do many problems of public policy.

Geography is a synthesizing discipline that tries to throw a bridge across the gap between the natural and social sciences. This role is dictated by the facts of man's distribution on the earth, and not by philosophy. As such, geography deals intellectually with problems strikingly like those confronting the legislator. It is

closer to policy-formation, which involves putting disparate things together, than any of the analytical disciplines. The fact that their discipline has direct relevance to the formation of a sound science policy leads geographers to hope that they will have a growing role to play if Canada moves forward toward such a policy.

Geographers can make significant contributions to one of the Science Council's⁽¹⁾ two prototype major programs - water resources management and development; to all four of its "areas for immediate planning"; and to at least three of its "areas for continuing consideration". Most of all the profession has begun in recent years to think constructively about the issue of a national science policy itself.

A National Science Policy

Geographers will generally accept O.M. Solandt's⁽²⁾ definition of science as "man's accumulated and organized knowledge about himself and his whole environment"; many of them would say that their own science has to do inter alia, with the spatial interactions of society with external environment. They will also accept his view that a national science policy means "a broad strategic plan for the most efficient and effective application of science in the solution of economic and social problems that arise in pursuit of the nation's goals." And they would accept, I believe, the Science Council's definition of those goals⁽³⁾.

They believe, however, that in Canada special attention must be given to the better use of land and resources, to the control of a harsh natural environment, to the amelioration of the nation's transportation net, and to the pressing need to rethink Canada's sprawling and chaotic urbanization. In all of these fields they can make a significant contribution, because of the methods they have developed, and of the substantive research in which they are engaged.

These contributions can be both theoretical and practical. We should not begin to lay claim to monopoly at any point, but geographers have established achievement in at least these domains:-

- Demographical spatial analysis
- Land use survey, planning and control
- Quantitative regional and interregional economic analysis
- Location and interaction theory
- Urban systems, considered primarily in morphological and functional terms
- Network theory (transportation and communications)
- Urban and regional development
- Resource surveys, conservation and development.

Clearly all these are areas in which other disciplines and professions are also relevant, and in many cases more relevant than geography. All we wish to stress is that a large and growing body of skill and expert knowledge exists among our membership in the above domains, and that we are zealous to apply these achievements, not only in advancing the national welfare, but in helping to plan that advance.

Geography is a discipline where the "pure" and the "applied" are close together. In my own view - though I cannot say how many of our members share this view - the justification for the broad synthesizing stance that we adopt is that the rational use of land and resources depends on such a stance. Many of us, myself included, are in this field because we want to influence the future, to create for mankind a happier, richer environment, and a society more in tune with the setting it chooses for itself. Because environmental choice is now an open option for advanced societies. And in that choice, the geographical environment is a major component.

It is no doubt because I have been advocating this cause for so many years, and because my colleagues agree with it, that the

Association asked me to submit this brief. In 1964, as President of the Association, I argued that "some of the (geographical) research done in Canada ought to be aimed directly at helping national development"⁽⁴⁾. Events since then have confirmed me in this opinion, and research has indeed shifted in that direction. Especially striking has been the rise of a strong school of urban geography⁽⁵⁾ at a time when Canada is waking up to the need to create a better urban environment.

In sum, I believe that professional geographers are almost unanimous in applauding the federal government's growing interest in national science policy. They hope that that policy will extend to the questions of land and resource use, urban and regional development, spatial organization and environmental relationships in which they are expert. And they hope that their voice may be heard by those whose responsibility it is to evolve such a policy.

How Can Geographers be Heard?

Canada already possesses a Science Council, a Science Secretariat and a variety of research councils. She does not, however, possess an Academy of Sciences, because the Royal Society of Canada has not played that role; nor does it serve as a consortium of the learned societies, like the American Council of Learned Societies or the International Council of Scientific Unions. In spite of the good work by the Science and Economic Councils, and their openness to suggestions from outside, the members of this Association still feel that their voice is not adequately heard. Possibly we have not been articulate enough. Part of the fault nevertheless still lies with the mechanics of consultation.

One feature of modern central government needs to be restressed. It is that things are more easily taken apart than they are put together. Departments and Cabinet ministers are assigned specific,

rather narrowly defined responsibilities. Much the same thing happens in a capital city as in a university. Geographers are criticized on the campus because they try "to synthesize wholes out of what a dozen specialist disciplines exist to take apart"⁽⁶⁾. In the same way, a national science policy must involve cross-departmental collaboration of a sort very hard to maintain, because departments have a vested interest in their particular bit of the whole. The United Kingdom Ministry of Land and Resources, for example, had an extremely short life because it was regarded as a cuckoo in the nest by other ministries. Its "remit" was to develop policy over a broad area, akin to what is now being described. It was quickly killed off,⁽⁶⁾ and not by public opinion.

Geographers are painfully aware of this inbuilt tendency. They are used to analytically-minded librarians whose system of classification spreads their books over other department's collections, leaving to geography only traveller's gossip. The old Department of Mines and Technical Surveys had a Geographical Branch that did yeoman work. It was recently dismantled, and its work and members spread over other branches. For many years the practice of central administration and universities alike has been to split the job up among specialists. It is my submission that this tendency must now be reversed. To talk of a national science policy implies planning well below ministerial or deputy-ministerial level; and it implies that synthesizing disciplines like geography will become both more relevant and more fashionable. The recent rapid growth of our membership confirms that others believe this.

It may be that the government's initiative in this direction will create new avenues whereby this profession may offer its advice. In the meantime, I call the Special Committee's attention to the existence of the National Advisory Committee on Geographical Research. Established by Order-in-Council P.C. 1965-693 of April 19th, 1965, it was reconstituted May 2nd, 1968, under Order-in-Council P.C.

1968-841, with the objective to

- (a) provide continuing advice to the Minister of Energy Mines and Resources on needs and priorities for geographical research in Canada;
- (b) assist in the co-ordination of geographical research in Canada;
- (c) promote the development of geographical research and review and make recommendations on applications for grants-in-aid of such research.

Membership consists of an Assistant Deputy Minister of Energy, Mines and Resources; up to six members from federal and provincial government departments, agencies and research councils; up to ten members from Canadian universities; and up to four members from Canadian industrial and business establishments and associations; provided that total membership shall be between eleven and twenty-one, inclusive. Of the present members, 15 are full members of this Association; and three of the business representatives are professional geographers.

The committee's present work is directed towards the profession and its research, and for this purpose the Association is on record⁽⁷⁾ as favouring a more prominent role for it, while seeking a voice in its composition. It seems worthwhile to recommend to the Special Committee that the Advisory Committee might be allowed to reverse its role, and serve in addition as a body carrying advice on policy questions to the government from the profession. Our strong representation on the Committee through our members gives us confidence in such a step, though the Council of the Association may itself wish to urge policy questions from time to time. It is not clear that the Minister of Energy, Mines and Resources will be the best recipient of such advice, if this possibility is acted

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upon. If a minister for science is appointed - and I am aware that government opinion is against this at present - he would be a more suitable choice.

Conclusion

I must offer, on behalf of the Canadian Association of Geographers, my thanks to the Special Committee for the opportunity to register these views. I hope that the Senate's initiative will lead to a lasting policy whereby the whole scientific community in this country can feel that it has a voice in, and hence a stake in, a national science policy. Because of our broad outlook - geography might even be called a cross-disciplinary discipline - we are particularly conscious of the difficulty of defining and then executing a consistent and effective science policy. All we ask is that this discipline, through its professional association as well as its individual members, be given the chance to help in the job.

F. Kenneth Hare
Vancouver, March 1st, 1969

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- (3) Science Council, op. cit., pp. 13-18.
- (4) F.K. Hare, "A Policy for Geographical Research in Canada", Canadian Geographer, 8, 1964, pp. 113-116.
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- (6) F.K. Hare, "The Conservation of Resources", Transactions and Papers of the Institute of British Geographers, no. 44, 1968, pp. 43-51.
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APPENDIX 120

BRIEF

TO THE

SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

SUBMITTED BY

THE SOCIAL SCIENCE RESEARCH COUNCIL OF CANADA
LE CONSEIL CANADIEN DE RECHERCHE EN SCIENCES SOCIALES

BRIEF
TO THE
SENATE SPECIAL COMMITTEE
ON
SCIENCE POLICY

1. Support for Social Science Research

The Social Science Research Council of Canada has, since its inception in 1940, been actively concerned with obtaining greater support for social science research in the university community. Prior to the establishment of the Canada Council this Research Council was the major national source of assistance for scholars working in the social sciences.

At the present time the SSRCC, supported by its membership, especially the learned societies representing the social sciences, is concerned to encourage and sponsor interdisciplinary research, and to encourage and facilitate communication amongst scholars and their various associations in the social sciences. Finally the Council administers a number of programmes in support of these objectives.

Since the establishment of the SSRCC increasing support for social science research has been forthcoming. It has not, however, kept pace with the growing needs of this portion of the academic community nor has it properly reflected the increased importance of this field of study in the post-war years.

In their submission to this Committee the Canada Council presented statistics showing that their budget for the social sciences and humanities programmes, not all of which are research oriented, has increased rapidly since 1964.¹ It is gratifying to note that this increase is to continue. But it is long overdue.

At the present time (1968-69) the Canada Council in their Annual Report 1967-68, estimates that the graduate enrollment in Canadian universities in the Social Sciences and Humanities is 16,200, some 55% of all graduate students enrolled. Though it is estimated that this

1. Appendix "1", The Canada Council Social Science and Humanities Programme, in the Senate of Canada Proceedings of the Special Committee on Science Policy, No. 1, p.30.
 1964-65 - 1,403,000.
 1965-66 - 3,117,000.
 1966-67 - 5,838,000.
 1967-68 - 11,614,000.
 1968-69 - 17,188,000.

percentage may remain constant, the actual enrollment will increase to almost 28,000 graduate students in 1972-73.

This rapid increase,² similar to that of the last four years has serious implications for the funding of research, not only for doctoral students, but especially for professional scholars involved in research in the university community.

The Council notes that "the scholarly community in the social sciences and the humanities is reacting to the climate of our time, which urgently demands intensified research. It is also evident that interest in our programme of assistance is increasing constantly".³

Indeed it is. That the Canada Council is the only major source of funds at the present time for free research in the social sciences is of considerable concern to this Research Council; a point to which we will return later in this brief.

The responsibilities of the Federal Government's Departments and Agencies have also provided the social science community with assistance for research. Although good basic research often develops from this assistance, funds are given for "mission oriented" research and stem directly from departmental responsibilities. The amount of money committed by departments for research in the Social and Behavioral Sciences was \$8,280,814, in 1967-68. Almost three-quarters of this amount (71.8%) came from two bodies: the National Research Council and the Department of National Health and Welfare.⁴

It is thus clear that Federal Government support of research in the social sciences -- apart from that offered by the Canada Council -- comes either from departments and agencies anxious to encourage mission oriented research of direct benefit to them in policy making; or from the National Research Council and the Department of National Health and Welfare in support of programmes of special interest to them. A large area of

2. Graduate enrollment in Social Science and Humanities in Canadian Universities

1963-64 5,800.

1968-69 16,200.

1972-73 27,800.

(Annual Report 1967-68 Canada Council, p.50)

3. ibid, p. 51.

4. Index of Federal Grants in Support of Extra-Mural Research in the Social and Behavioral Sciences, 1967-68. (Special Planning Secretariat, December 1967.)

important social science research, much of it of a fundamental kind, is supported only by the Canada Council.

It may be useful to note that in their report on scientific research and development, the Commissioners of the Royal Commission on Government Organization neglected to mention the government's activities in the field of Social Science Research.

It is unnecessary to elaborate further on the inadequate support for social science research in Canada. And yet, how can we in Canada expect our governments to confront successfully the wide variety of social problems without a significant increase of knowledge in the social sciences, which is to say, increased research in these fields. Increased technological and scientific knowledge and expertise (to which the federal government has lent strong support) has also presented challenges to which the social scientist must now address himself.

In the International sphere we find that the non-scientific terminology of "nationalism", "Culture" and "human values" are absorbing increased amounts of attention and concern. That Governments in Canada, and especially the Federal Government, should not be more concerned with fostering the development of basic research in the broad areas which bear on these crucial questions for domestic and international benefit seems incongruous. We believe that it is in the interests of the Government of Canada, as well as social scientists in this country, to give financial encouragement to innovative studies in the social sciences. Such support could be significant in overcoming the inadequate attention these disciplines have received in the past, and would contribute to increased confidence and ability within our community in the future.

2. Implications of Federal Support of Research

The various activities of the Federal Government supporting research in the social sciences have been referred to earlier. Their totality is unknown due to the lack of adequate information. We are aware of the limitations of the Index referred to, prepared by the Special Planning Secretariat in December 1967. The recent study, Federal Expenditures on Research in the Academic Community⁵ though much more extensive than the

5. Federal Expenditures on Research in the Academic Community 1966-67; 1967-68 Report No. 1 Education Support Branch, Department of the Secretary of State, Ottawa 1968.

earlier Index, still does not indicate to what extent research is supported in particular disciplines or even general fields.

Through research programmes of some Royal Commissions, social scientists in Canada have been able to make significant contributions to the Canadian society. At the same time, the extensive (and expensive) research carried out by the Royal Commission on Bilingualism and Biculturalism served to point out clearly the appalling lack of basic research on one of the major Canadian phenomenon. Important work still needs to be done on a myriad of problems and situations that have not yet been forced to public and political attention.

Research projects for government departments and even Royal Commissions though limited in scope and quantity are directed to immediate situations and are almost entirely "mission oriented". Research of this nature is, as implied above, a proper function of the academic community. Indeed, it would be futile, as Dr. Michael Oliver has pointed out,⁶ and "contrary to the public interest to resist the demand that part of our social science research capacity be devoted to the analysis of those problems that interests outside the scholarly community regard as the most important. . . . But the dangers of community-generated research over balancing scholar-generated research are clear and disturbing and they are the greatest where government and business concerns coincide."

That governments should be one of the instruments of "community-generated" research is unquestioned. Certainly some of the major works in economics, for instance, can be described as "community generated". The diversity of interest between Government, academics, and the private sector is often not great. At the same time there should be no question that governments ought to bear some of the responsibility for ensuring a healthy balance, between the scholar and the community. Thus, if government is to fund "mission oriented" research, it should be concerned to provide resources for that research which emanates from the scholarly community.

It is only on the basis of sound scholar-oriented research, that which comes from within the academic community, that government can expect

6. Michael Oliver, Research In the Social Sciences, a paper presented at the Centennial Conference of the Association of Universities and Colleges of Canada; Montreal, 1967.

to receive the results of thorough research which can then inform on their particular objectives. At the present time this "basic research" in the social sciences does receive support. The two major sources are the university and the Canada Council. Though there is this support without its continued development it becomes continually and relatively weaker.

3. Research Needs in the Social Sciences

Even though the work of the social scientists in today's university is involving him with the use of expensive and sophisticated technical equipment, the basic tool of most researchers, remains the book, and consequently the library.

For the most part libraries in Canadian universities fall far below the standards required for adequate support of scholarship and especially of research. Adequate library resources are not only important determinants of the quality and quantity of research; they are vital if Canadian universities are to attract and hold first class research and teaching personnel. As an indication of the pressing needs in this one area alone is the recommendation of a study completed in September 1967 that additional appropriations totalling \$150,000,000. for collection development will be required over the next decade.⁷ As well, if Canadian researchers are to be aided in their work, libraries must be encouraged to keep pace with the rapid technological developments taking place in the concepts of information retrieval. This Council recommends that concentrated efforts be made to establish a nation-wide information retrieval system centered on Canadian libraries. Related to this is the Council's present investigation of the possibilities of establishing a computerized bank of social science data and information.

It is also evident to this Council that priorities in assisting free research as well as "mission-oriented" work must include a realization that the demands of modern research involve such necessary tools as data banks, computer centres, survey centres, information retrieval centres, and similar aids. Large sums of money will be needed to establish these

7. Robert B. Downs, Resources of Canadian Academic and Research Libraries, Ottawa, Association of Universities and Colleges of Canada, 1967; p. 6.

facilities, and their major support should come, in our opinion, from the Federal Government. There should be a considerable number of these centres (at least five) across the country in order to provide that infra-structure which has now become necessary for work.

Turning from the technics of research to the needs of personnel, it is apparent that a substantial increase in support is required immediately and that further increases will be needed from year to year if research is to be maintained at a level which the community requires and which is now and will continue to be within the capacities of university personnel. The observation of the Bladen Commission in 1965 is equally true today: "There has been little evidence of recognition of the gross inadequacy of the funds for research in the Humanities and the Social Sciences, perhaps because the economic yield is less obvious and less certain. The need here is very great if we are to play our part in the civilized world".⁸

There are several reasons why there is a rapidly growing need for funds to finance research in the Humanities and Social Sciences. The size of the academic community is growing rapidly.⁹ This is seen in the increased number and size of academic institutions. Such a quantitative increase must be matched by the opportunity for qualitative development. Without positive encouragement of research in Canadian universities we may find that in the social sciences competent researchers will be drawn into mission oriented research contracts which provide the resources to free them from other duties. As a consequence many other researchers will be so burdened with the heavy teaching associated with burgeoning registration that their needs for research leave (both of short-term and of the older sabbatical type) will be much greater. Furthermore with the pressures anticipated in student numbers the number of second rate or intellectually obsolete departments may become dangerously high.

There is thus a much greater need for specialized research centers providing research opportunities and retraining programmes. To these centers university teachers of social science could repair from time

8. Financing Higher Education in Canada ...; published for the Association (of Universities and Colleges of Canada) by the University of Toronto Press and Les Presses de l'Université Laval, 1965; p. 75.

9. See DBS Publication 81-203 University Salaries and Qualifications.
Total University Staff in Social Sciences:
1963-64 - 2,409.
1965-66 - 3,435.
1966-67 - 5,121.

to time to increase their research skills.

Again, if the present lack of support is permitted to continue the country will not develop in the foreseeable future centres of excellence in the social sciences which can have an international reputation. The present formula financing of Canadian universities, based on student enrollment tends to prevent the development of centres of academic excellence. The provision of an increased number of senior fellowships would do much to expand the research potential of scholars, and consequently to encourage the development of specialized and highly qualified research centres.

A third factor accounting for the increase in financial need is the greater cost of certain newer research methods. We need only cite as examples, the costly survey research, the areas of interdisciplinary research with their teams of directors and supporting personnel and the necessity in much research of having access to expensive equipment. There is a greater demand also for research supporting services such as data banks, statistical centres, computing centres and, of course, large library collections.

We have emphasized, up to this point, research in itself. But one of the important by-products of research arises from its training function, and is the provision of scholars familiar with research techniques. The training of competent researchers is critical. Not only are they increasingly in demand by government, they are being asked to take on increasingly difficult tasks. At the same time governments must plan to expand their own in-house research staffs and activities. A major component of this plan ought to be to ensure that those people coming into government as researchers have been competently trained and are well qualified to accomplish significant research.

4. The Sources of Support for the Social Sciences

In his statement to the Federal-Provincial Conference on October 24, 1966, Prime Minister Pearson made it quite clear that in the view of his government, it is a federal responsibility to support research for cultural, social and economic development and to support other means of fostering cultural developments, e.g., the National Gallery and the

National Film Board. We are encouraged, therefore, to urge that you press on the Federal Government the necessity of contributing substantially larger sums for those fields of research in the social sciences.

While we concern ourselves here only with Federal Government aid to research, we do not, of course, imply that this should be the only source of research funds. We hope that provincial governments and industry will contribute large amounts for this purpose.

We should like to emphasize the vital importance of having several rather than only one source of support for research in the social sciences. No matter how careful and objective the judgment of research applications may be, and no matter how independent and impartial the granting agency may be in its decisions, the fact remains that in the humanities and the social sciences there are a variety of ways of looking at research problems. Some of these new approaches may not yet be acceptable to the academic establishment which is likely to advise on the use of funds; others may deal with topics so sensitive on political or conventional moral grounds that existing granting agencies may be hesitant to back them. In any event, both the humanities and the social sciences involve research innovations which may challenge conventional notions of respectability to the point that a variety of sources of research support will be more likely to take account of all fruitful lines of attack.

It is our firm conviction that through the existence of several sources of research support there can be the true freedom of the researcher to find the support he needs when he needs it and in the manner he needs it. Accordingly, a sound policy of research support from our point of view will not discourage various departments and agencies of government - federal and provincial - as well as private agencies from offering to support scholars who may appeal to their interests. Over-rationalization of support for research may appear to be economical, but it may also be seriously restrictive to original research.

We favour an increase in the number of channels through which federal funds may be made available for research. An increase in the flow of funds through, say, the Canada Council, should not inhibit the flow of funds for research through government departments, royal commissions, the Economic Council of Canada, the National Library (for research materials) and the

like. We would suggest that new channels for the direct flow of research aid be through, for instance, the Department of Justice, the Public Service Commission, the Privy Council Office, the National Museum, the Universities through block grants for research, the Humanities Research Council of Canada and the Social Science Research Council of Canada. There would no doubt be overlapping jurisdictions in such a plan. But this we consider to be a source of strength. In view of the multiplicity of interests, the controversial nature of some research topics, especially in the Social Sciences, and the necessity of supporting both "pure" and "applied" research it seems to us that the existence of several granting bodies supported by Federal funds would better serve the overall requirements of research than only one.

In this connection, the rôle of the Social Science Research Council and the Humanities Research Council in directly supporting research with Federal funds should not be overlooked. With an organization providing contact with universities and scholars in the Social Sciences and Humanities, both this Research Council and the Humanities Research Council of Canada are well equipped and ready to advise on the research priorities.

5. The Need for Strengthened Support for Social Science Research

Broadly speaking, and as we have already emphasized, we urge that the funding of free research by the Federal Government should increase, not only to balance those funds allocated for mission-oriented research, but to meet the legitimate needs of Canadian social scientists. One of these pressing needs is assistance in the form of summer supplements and stipends to enable researchers to reduce teaching loads for limited periods and to complete research projects.

Both types of stipends are widely used in the United States. Their provision would improve the competitive position of Canadian universities vis-a-vis American institutions. With assistance programmes of this sort the Canadian academic community could more easily attract to this country, Canadians now in the United States or abroad. Such assistance would also reduce dependence of researchers on contract research and to that extent leave them more freedom of choice as to their research commitments.

Of particular importance for Canadian scholars are small specialist meetings to review research problems and plan with concentrated efforts for

new departures in research activities. The difficulties of communication amongst scholars within this country would render such gatherings of major significance.

As well, there are interdisciplinary and other joint studies, the planning of regional research facilities such as data banks, survey centres information retrieval centres and the establishment of research centres. This Council has supported, with Canada Council assistance, a study concerning the establishment of a data bank for social science information.

The "Bladen Report"¹⁰ recommended: "That all Federal Government Research Grants to Universities . . . for operating expenses and all fellowships tenable in a university . . . should carry with them a 30 percent supplement as an unconditional grant to the university." In the past research overhead costs were relatively modest and were absorbed by universities. But now, with the increased volume of research and the increased costliness of modern research methods, special financial provision must be made to cover these overhead costs.

Interdisciplinary studies are becoming more and more important in the social sciences, and extend to other disciplines in the humanities and the natural sciences. These studies are especially costly since they usually involve travel, the payment of research assistants and other staff as well as the accumulation of data by surveys and the like. There is, as yet, no established and relatively certain way of funding studies of this sort.

Funds are needed to assist in the training of research assistants, and far more graduate and post-graduate fellowships are required.

At present, there is a problem in finding support for research projects which do not fall clearly within jurisdiction of the present funding bodies, or which cut across several jurisdictions.

The "Bladen Report"¹¹ recommends that the Canada Council budget for the humanities and social sciences for 1966-67 should be at the level of \$15 million,¹² and should be increased at the rate of 20 percent each year

10. p. 69

11. p. 69

12. The estimated expenditure in the social sciences and humanities programme was, in fact, \$11.6 million.

thereafter. Of this total some \$2 million was recommended as grants to university libraries for the development of their research collections.

The Council's budget already sadly lags behind these objectives established in 1965. This disturbing difference between "the recommended" the "actual" continues to grow, in spite of the rapid increases in the budget of the Canada Council. To further assist the funding of "free", "scholar-generated" research, the SSRCC would propose that it be supported directly by the Federal Government. Such support, in the form of an endowment would give the Council considerable flexibility in sponsoring those activities which are of value within the scholarly community. It is worth noting that in 1967-68 the National Research Council committed some \$40 million to the support of Research and Development in universities. While it is true that expenses in the natural and physical sciences are often necessarily larger than in the social sciences, this figure was an increase of \$10 million over the previous year. In 1968-69 a similar increase is estimated.¹³

We suggest that with the addition of funds from federal and other sources the SSRCC could offer needed support for a variety of scholarly activity.

6. The Social Science Research Council and Consultation with Government

A very different situation which requires serious attention is the structural organization of a dynamic and efficient science policy for Canada.

One of the basic components of such a policy from the point of view of the SSRCC is that advice on the social sciences should be given by those familiar with those disciplines. We view with some alarm the possible influence of the Science Council of Canada in areas of the social sciences and even the humanities.¹⁴

In publishing Report #4, Towards a National Science Policy for Canada, the Science Council of Canada has provided a statement which is revealing. The goals set out are quite arguable. But what this Research Council views with considerable concern is the very real involvement of the social sciences in all these goals. Yet within the membership of the

13. Appendix M "Financial Information", Brief by the National Research Council to the Senate Special Committee on Science Policy. Proceedings of the Special Committee, #3, October 23, 1968, p. 262.

14. In the First Annual Report 1966-67, of the Science Council it was pointed out that, "the Science Council's activities will certainly be centered upon the natural sciences and engineering but must also have affinities with the social sciences and possibly even some aspects of the humanities".

Science Council itself there is only very marginal representation of those same disciplines.

Difficulties with the interpretation of the rôle of the Science Council of Canada were experienced when that Council established a project inquiring into the Support of Research in the Universities. The organization of this project initially under the aegis of the Science Council of Canada, with its broad objectives and implications for the social science community in universities justifiably roused "considerable interest" particularly in the social sciences. Through the efforts of this Research Council, the Humanities Research Council and the Canadian Association of University Teachers, the project was co-sponsored by the Canada Council. With this involvement of the social sciences and humanities, the membership of both the Study Group (led by Dr. Macdonald) and the Advisory Committee (Chaired by Dr. Roger Gaudry) was modified.

We suggested earlier the possible involvement of this Research Council as an advisory body for government purposes. The involvement of the Canada Council as a co-sponsor of this project, to study the support of research in the universities shows clearly that body's anomalous position. Unlike the Science Council the Canada Council was not constituted to advise the government on matters of policy in the social sciences and humanities. As Mr. Frank Milligan, Assistant Director of the Canada Council, indicated in his comments before your Special Committee, "The Canada Council is essentially a bureaucratic organization."¹⁵ The Canada Council has as its main task the efficient processing of applications and the duty to preside over the processes of adjudication on which its programmes rest.

This discussion of the Science Council of Canada and the Canada Council has served to point up the very real difficulties which exist in providing the decision making processes of government with the views of the scholarly community in the humanities, and social sciences. We are anxious to ensure, in the most effective way, that the governments of Canada and especially the Federal Government should have the best possible advice presented to them. This can be most effectively presented by scholars in these same fields where governments plan to move. In the case of the SSRCC, the Social Sciences are the major concern.

It seems to us of great importance that, before major policy decisions are made, there must exist an advisory machinery through which

15. The Senate of Canada Proceedings of the Special Committee on Science Policy, No. 1, p. 14.

the most authoritative advice from social scientists can be expressed and taken into account. At the present time the SSRCC is moving to ensure direct representation of learned societies in the social sciences on the Council. Such a step will assist in providing more effective advisory machinery for government, if advantage is taken of it.

We do not believe that a revised or reshaped Science Council can satisfy these needs. With its secretariat and its membership already deeply involved with the natural sciences the addition of a social sciences division could, in our opinion, not be successful.

The principal objective is to have bodies which can speak with authority to the Federal Government -- its departments, and political sectors and the other bodies in Canada and abroad as to the research needs in the social sciences and their priorities. The combined voice of the learned societies in the social sciences speaking through the Social Science Research Council of Canada could do much to facilitate the provision of this advice and information.

It is crucial that the Government be able to evaluate its practices, policies and programmes from various points of view. Broader national interests must receive attention. This Council because of its close relations with the academic community would be able, we believe, to provide the Government's policy makers with sound advice.

APPENDIX 121

Canadian Economic Association

(Association canadienne d'Economie)

Brief to the Special Senate Committee on Science Policy

March 1, 1969

Executive Council:

M. C. Urquhart, President
W. C. Hood, President-elect
Gilles Paquet, Secretary-Treasurer

Committee on Research Support:

Anthony Scott, Chairman
A. Fauchet
T. I. Matuszewski
Grant Reuber
Ronald Shearer

I. CONCLUSIONS and RECOMMENDATIONS

The Canadian Economic Association wishes to place one main conclusion before the Senate on Science Policy:

more and better economic (basic or applied) research in economics in Canada (in government, business or the universities) depends uniquely on first building up a stock of first-rate Canadian and foreign-trained economists, to man and develop the graduate schools, teach the teachers, and initiate better and more sustained research. The present stock is far too small and too weak.

This brief indicates why Canada cannot yet train, attract, retrieve or hold a stock of adequate size or quality, and suggests essential policy steps for correcting this situation.

In previous statements, in discussions with the MacDonald study group, with the SSRCC and the Canada Council, the Association has also suggested its opinion of alternative organizational systems, and of the amount of research support. But compared to the critical stock situation outlined in this brief, the amount or organization of research support is a minor problem in our larger theme.

II. NATURE and OBJECTIVES of the ASSOCIATION

The founding of the Canadian Economics Association in 1967 reflected the increased professionalism of Economics in Canada. Nearly all its active members are trained economists, and nearly all are closely associated with research activities. This situation differs sharply from that of fifteen years ago, when the parent Canadian Political Science Association not only included members of four or five social-science disciplines as well as many laymen with a general interest in Canadian society and polity, but also excluded a large number of eligible academic economists and civil servants who found that the old Association and its more general Journal did not answer their research needs.

The distinctly economic Canadian Economics Association (with close ties with the Societe Canadienne de Science Economique) now issues a quarterly Journal of more than 150 pages to over 3,000 subscribers around the world; conducts annual meetings on professional topics; and is making plans to aid its members in research and publication in a variety of ways. Its constitution, approved in 1967, states its goals as follows:

The Association has for its object the advancement of economic knowledge through the encouragement of study and research, the issuing of publications, and the furtherance of free and informed discussion of economic questions. The Association as such will not assume a partisan position upon any question of practical politics nor commit its members to any question thereupon.

Many Canadian economists also belong to or subscribe to the journals of foreign national economic societies, and most keep in touch with their own particular lines of research or controversy through specialised journals published by groups centered in other countries. Most Canadian economists were trained abroad, and still send most of their potential Ph.D. students abroad for graduate training and research.

III. THE IMPORTANCE OF ECONOMIC RESEARCH to CANADA

Economics, as a science, is concerned with the social problem of making the most effective use of the limited resources which we have at our disposal. These resources include not only our raw, natural resources, but also the labour force, and the capital goods and knowledge which we and our ancestors have created. Almost every significant decision that we have to make, whether as individuals or collectively through the government, involves a choice among alternative uses of our scarce resources -- that is, almost every significant decision introduces an economic problem. The broad sweep of the discipline leads economic researchers to inquire into almost every aspect of our national life.

Frequently such inquiry leads further, to recommendations to change the nature of private institutions so that they, and society, may achieve a more effective use of our scarce resources. Frequently, it leads to recommendations for changes in the way in which governments pursue. It is not surprising perhaps that governments, among others, are making increasingly insistent calls upon the Canadian economics profession for advice, but advice is valuable only if it is firmly rooted in economic research.

As in other sciences, most economic research can be classified as either "pure" (i.e., theoretical) or applied (i.e., directed to specific problems). Unlike most natural or physical sciences, however, historical research is also a vital concern.

Applied Research

The value of applied economic research should be evident from what we have already said. This is problem-oriented research, frequently motivated by major issues of social policy. Statistics, mathematics, computer science, law, sociology and politics are frequently involved, along with basic hypotheses distilled from economic theory.

One index of the importance of applied economic research to the on-going concerns of governments in Canada is the fact that few government departments now find that they can function effectively without a staff of applied economic researchers. In addition, governments in Canada have found it necessary to establish several more specialized economic research agencies, such as the Research Department of the Bank of Canada and the Economic Council of Canada. These are in fact centers for broad sweeping applied economic research in particular areas. As a result, governments in Canada are among the major employers of economists. However even with this very large internal staff, governments at all levels commonly find it necessary to call upon academic economists for short-term research assignments. This may be done through the vehicle of a Royal Commission, a Task Force, or some other commission of inquiry. One need only cast his eye over the work of such commissions appointed in recent years to appreciate the role which economic research can and must play. This is obviously true of those recent major commissions which have been appointed to explore questions of obvious economic content, such as the Royal Commission on Canada's Economic Prospects, the Royal Commission on Banking and Finance, the Royal Commission on Taxation, the Task Force on Industrial Relations, and the Task Force on the Structure of Canadian Industry. A more exhaustive list would also mention the many provincial inquiries. The same reliance on economic research, however, is to be found in the many commissions which are not obviously "economic" in nature: economists made major contributions to the work of the Royal Commissions on Health Services, the Royal Commission on Bilingualism and Biculturalism, and various provincial commissions of inquiry into the educational system. Indeed it could be pointed out that the Science Council of Canada itself has found it necessary to seek advice of economists in the course of their studies of science policy for Canada, and we presume that the Special Senate Committee on Science Policy will also find this necessary; science policy involves economic issues that are both of enormous national importance and intriguing technically.

It goes without saying that business firms throughout Canada also find applied economic analysis vital to their operations. They frequently hire academic economists as consultants, and many undertake continuous in-house research.

It should be stressed that the publication of the results of economic research into Canadian economic problems can also be a vital factor molding the general climate of informed lay opinion. If the community is to participate constructively in the determining of the nation's economic policy, it must be exposed to relevant and correct research results.

It should be evident from what we have said that much applied economic research is ad hoc in nature, done under contract or at the specific request of corporations, trade associations, governments or international agencies concerned with a specific problem of immediate urgency. However, the continuing core of applied research must have academic roots. It must, and does, grow out of the economists' own interest in exploring the nature and functioning of the Canadian economy. Applied research of this sort gets published in professional journals or in monographs and books, and leads to an accumulation of knowledge about the economy which is then available to other economists and to those responsible for making policy decisions.

A science policy for Canada must recognize the fact that:

too high a proportion of the financial support for applied economic research in recent years has been for contractual research. Applied economic research cannot proceed on an ad hoc basis. There must be continuing financial support for academic research, which leads to an accumulation of published knowledge, and provides the background for many specific, ad hoc inquiries.

Pure Research.

While the immediate value of applied economic research to Canada should be quite obvious, the national value of theoretical research may be less clear. The product of applied research has direct implications for business decision or policy formation in Canada, but the product of pure research is really international in its relevance. It tends to be abstract, general and mathematical. Economists who are inclined to do pure research will mostly do it regardless of whether they are located in Canada or abroad, and the product of their research will be available to applied economists working in Canada through the mechanism of the journals of world-wide circulation. The research will get done and the quality and relevance of the research will probably not be affected by where it is done.

Although Canadian economists can quite readily import the product of foreign theoretical research in economics, there are major benefits from having a number of outstanding theoretical economists resident in Canada. These all arise from the central role of the graduate school as the combined home of graduate instruction, research, and undergraduate teaching. The graduate student and the research professor not only need assistance with new or basic theoretical points underlying their own applied inquiries, but also seek daily contact with theorists who are capable of abstraction, perceptive re-appraisals and who search (appropriately) for economy of method and logic and exactness of statement. It is not enough for an economist to subscribe to a number of theoretical journals; each applied research group should also include persons who primarily teach, read and discuss theory.

Sound training in economics at all levels requires sound training in economic theory, and the best training in economic theory will be provided, by an large, by the best theorists. Only if Canadian graduate schools have first rate theoretical economists will they turn out students with the real depth of technical competence and imagination that leads to the students themselves developing into first rate applied, theoretical or historical researchers.

Canadian science policy must recognize this fact.
Universities must provide salaries to attract first
 first rate theoretical economists, and research
 funding agencies must provide research funds to
 support their necessarily esoteric research.

Historical Research.

The importance of historical research has certain characteristics in common with theoretical research. That is, it is not usually directly oriented to the solution of current problems of pressing concern, though such problems may suggest historical questions. However, economic policy cannot be constructed without some understanding about the nature of the economy with which we are dealing and the forces which have shaped its development. It is a clear understanding of these processes which historical research alone can provide. Experience has shown that scholars resident outside of Canada are much less likely to engage in research on Canadian economic history than are scholars resident in Canada. A distinctive Canadian approach to economic history has already appeared.

Again, this is a fact which must be taken into account in framing science policy.

If we are to have a thorough understanding of the nature
 and development of our economy, financial support must be
 provided for purely historical economic research in Can-
 adian universities.

The Objective of a Science Policy for Economics in Canada

We have stressed that high-quality economic research of all three types can make a major contribution to policy formation at every level of government in Canada. However, high-quality economic research depends on the presence of economists of outstanding ability resident in Canadian universities.

The primary objective of a science policy for economics
 in Canada should be to provide the resources necessary
 to accumulate and retain a stock of outstanding applied,
 historical and theoretical economists in Canadian universities.

IV. THE PRESENT SITUATION IN RESPECT TO THIS OBJECTIVE for SCIENCE POLICY

There is abundant evidence that we are presently falling far short of this objective. While there are probably over 400 economists resident in Canadian universities (and perhaps another 200 in business and governmental employment) neither their average professional quality nor their number is yet adequate to satisfy current Canadian requirements. There is a critical and well-documented shortage of economists of outstanding ability and international reputation in Canadian universities. Moreover, this is a situation which is not to be rapidly corrected, either through the attraction of outstanding international scholars or through the recruitment of the outstanding new Ph.D. students coming on the market each year.

The documentation of the underdeveloped state of economics in Canada is of several sorts. For example, in 1966, Professor H. G. Johnson demonstrated the paucity of developments in economics in the post-war period. Although many economists of Canadian origin have played a vital role in the development of the science in this period of time, almost without exception these economists have done most of their outstanding work while resident in universities outside of Canada, usually in the United States. They have not been available to lend their stimulus, prestige and personal talents to the development of economic research and teaching, or the study of economic policy, in Canada.

Equally grave is the difficulty which most governmental commissions encounter in recruiting economists of superior quality to do the research which they require. While they generally succeed in hiring some economists of superior abilities (sometimes hiring them from foreign universities), they must also make do with many less-talented professionals. The predictable result is a general complaint from government agencies that the research for which they contract from academic economists is frequently of poor quality. The fact is that the few outstanding economists resident in Canada are spread far too thinly to do an effective government research job while at the same time maintaining their own research, teaching, and administrative commitments.

Also disturbing to the Canadian Economics Association is the trickle of high-quality professional research on practical Canadian problems, not done under contract for governmental agencies or commissions, but growing out of the scholar's own interests and published in professional journals like the Canadian Journal of Economics. This, just as much as contract research, should be a prominent flow in the output of applied economics in Canada.

The final and equally devastating symptom of the poor condition of economic research in Canada is the disappointing failure of graduate studies in economics to develop as rapidly as other disciplines at Canadian universities.

Canadian universities have had outstanding success in developing undergraduate programs in economics. Graduates of honours programs in economics from Canadian universities are internationally recognized as among the best prepared entering graduate studies .

A beginning has been made in the development of graduate studies and research in economics at several Canadian universities. However, as Professor Scott noted in his presidential address to the Canadian Political Science Association in 1967, graduate studies in economics has been "undergraduate propelled". It has not developed an internal momentum of its own. As a result, it is still true that almost all of the best Canadian students go abroad to take graduate degrees in economics, and Canadian graduate schools do not attract a compensating number of outstanding students from other countries. As a result Canadian researchers in economics must work with and lecture to a body of students whose potential is not outstanding. Many of these graduate students find it impossible to complete a Ph.D. degree successfully. Canadian Ph.D.'s teaching at Canadian Universities are still rare, and only a few Canadian Ph.D's can yet be described as above average by North American standards.

Coupled with this lack of broad or strong graduate training in economics at Canadian universities is the associated difficulty which Canadian universities find in retrieving the very outstanding Canadian students who have gone abroad to do their Ph.D. work. Many American universities' economics departments still rely on outstanding Canadian professors.

To conclude, we point with concern to the main weakness in the present situation:

the Canadian economics profession is spread very thinly. Many of the potentially outstanding economic researchers are hampered in their research efforts by all-absorbing burdens of undergraduate teaching. Of the research that they do accomplish, far too much takes the form of consultations or contract research on specific problems, and far too little represents truly academic research. Partly, as a result, there are very few economists resident in Canadian universities who can be said to have outstanding international reputations. Again as a result, graduate studies in economics at Canadian universities has not yet developed vigorously. Moreover, and what is very disturbing, this circular situation does not seem to be improving rapidly.

V. IMPLICATIONS FOR SCIENCE POLICY

We have tried to make clear the single essential objective of science policy in the area of economics in Canada. There is a major national interest in the development of a stock of outstanding pure, applied and historical economic researchers in Canada. The question is what combination of policies is necessary to achieve this objective.

In the short run we must attract more established scholars with outstanding international reputations. With an eye to the long run, however, we must also attract a much higher proportion of the outstanding young economists coming out of universities throughout the world, and provide them with the research facilities to develop their potential.

To achieve these objectives, action is required on several levels.

1. The university environment must be improved.

(a) If we are to attract established scholars of international reputations and young scholars with outstanding potential the universities must be financially able and prepared to pay internationally competitive basic salaries. This is rarely done today. It means that the universities must be prepared to pay economists salaries which are higher than is common for many other academics in Canada.

(b) Basic salary is only part of annual remuneration. Supplementary summer stipends for economists willing to devote their summer to purely academic research (whether in the applied, theoretical or historical categories) have become commonplace in leading United States universities. These stipends are generally set at 2/9ths of basic salary. If Canadian universities are to be internationally competitive and if the best of Canadian economists are to be attracted away from contractual research to academic research, a similar policy must be adopted by universities in this country.

(c) Direct remuneration is far from the only consideration in attracting outstanding scholars to Canada. Canadian universities must match the lower teaching loads of leading European and United States universities to compete in the international market place, and to provide adequate time for research.

(d) Better ancillary facilities must also be provided. In many universities this means the provision of space for research activities and research assistants. In some universities it means better computing facilities, although in some universities, thanks to pressures emanating from the natural and physical sciences, computing facilities are quite adequate. Canadian university libraries -- while generally adequate for undergraduate teaching (aside from

pressing shortages of space) -- are notoriously second-rate from a research point of view. Few libraries are adequate to support intensive scholarly, historical, or institutional research on other than a very narrow range of Canadian topics.

2. Financial support for graduate studies must be made more effective.

(a) At present, most of the financial support for graduate studies and research is derived from provincial sources, generally as a by-product of arrangements made for the financing of undergraduate studies. The development of graduate studies in economics is also a national concern, which ought to be accompanied by increased national financial support.

(b) The primary source of federal support for graduate studies is through Canada Council Fellowships. Most of the awards in economics are to Canadian students at foreign graduate schools. No barrier should be raised to outstanding Canadian students attending outstanding foreign graduate schools when comparable training is not available in Canada. However, Canada Council financial assistance should not be equally readily available to Canadian students choosing to attend less distinguished foreign graduate schools, when comparable programs are available in Canada. (Many members of the Canadian Economics Association feel that a quota should be established on Canada Council Fellowships tenable at foreign graduate schools).

(c) Canada Council Fellowships are only available to Canadian citizens or landed immigrants. However, part of the objective ought to be to develop graduate studies in economics at Canadian universities, drawing the best graduate students which can be attracted regardless of their national origin. Some Canada Council Fellowships ought to be made available to outstanding foreign graduate students, tenable at Canadian graduate schools. Many Canadian students of indifferent quality presently receive Canada Council awards. These funds would be better spent if diverted to the attraction of outstanding foreign students.

3. Stronger efforts must be made to attract established economists of proven outstanding ability, and young scholars of outstanding potential. A national strategy requires imaginative form as well as financial support.

(a) To this end, the federal government could well establish research professorships at a few universities which have a demonstrated willingness to develop high quality graduate programs in economics. Such a professorship would involve an internationally competitive salary for the notable scholar, adequate research funds, and an adequate overhead grant to the university to permit it to provide the necessary ancillary facilities and staff.

APPENDIX 122

BRIEF

TO THE

SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

SUBMITTED BY

CANADIAN SOCIOLOGY AND ANTHROPOLOGY ASSOCIATION
SOCIÉTÉ CANADIENNE DE SOCIOLOGIE ET D'ANTHROPOLOGIE

Special Committee

BRIEF TO THE SENATE SPECIAL COMMITTEE ON SCIENCE POLICY*RECOMMENDATIONS

The Canadian Anthropology and Sociology Association respectfully recommends:

1. That the Federal Government appoint in the research branches, top grade staff and consultants, trained in sociology and anthropology, who can define the research that is needed by the Federal Government and who are in touch with the latest developments in the social science disciplines.

2. That the Canada Council, as the principal independent agency dispensing research funds in the social sciences, and any other agencies that are established in the future, should work with the social science learned societies for the purpose of increasing the number of qualified young members of social science disciplines who assist both in the determination of policy in the area of research grants and in the evaluation of applications for such grants.

3. That the present policies based on the separation of support for graduate education on the one hand and research on the other, should be abandoned: it should be recognized that they are very closely interdependent and the policies of granting agencies should be changed to reflect this.

4. That substantially more long term financial support should be made available for research institutes attached to universities, for equipment and supporting services such as technical assistants, secretarial services, and other administrative costs. Such support should not only be made available upon the submission of particular research projects, but also on the basis of long term research output.

5. Given the enormous and rapid growth in anthropology and sociology in the last five years in Canada, in terms of both faculty and

* In preparing this Brief, the report prepared by Mabel Timlin and Albert Faucher The Social Sciences in Canada/Les Sciences Sociales au Canada (Ottawa, Social Science Research Council of Canada, 1968), as well as Desmond Connor's Directory of Sociologists and Anthropologists in Canada have been used. The marginals from this last report form the basis of the tables in Appendix "A". Data have also been used from a study carried out on behalf of the Committee of Chairmen, Departments of Sociology and Anthropology in Ontario, 1968, and data from various briefs presented to the Macdonald Committee.

graduate students, we recommend at least a comparable increase in financial support for research in our disciplines.

A. Recent Trends in Sociology and Anthropology in Canada

Sociology and Anthropology have been undergoing a spectacular growth period in Canada. The magnitude and recency of this growth can be seen in the following summary statements based on recent surveys of the Canadian scene.

In 1950, there were seven universities which offered programs in Sociology and four in Anthropology. In 1968, there were forty-two universities and colleges which offered programs in Sociology, thirty-one in Anthropology. Since 1960, there has been a six-fold increase in the number of separate departments established.

The population of professional sociologists and anthropologists in Canada has quadrupled during the past 18 years. There are about 500 persons who possess a permanent Canadian address and an M.A. or Ph.D. in Sociology or Anthropology, or a closely related field, and who claim a current speciality in sociology or anthropology. About seventy per cent of this population claims a sociological speciality, most of the remainder a speciality in anthropology. No fewer than 335 (67%) of the professional population to which we refer have taken their highest degree in the past eight years, that is, since 1960.

To illustrate the absorption of most anthropologists and sociologists in teaching, 75% of the population claiming sociology and anthropology as a specialty are employed in universities. The distribution of the professional population among different employment agencies can be seen in Table I, in Appendix "A". It is worth noting that an American study showed that about 10 years ago the same proportion, 75%, of professional sociologists were in university employ.* Recent studies show that only about 69% of American sociologists are employed in American universities. This indicates a broadening of opportunities in non-university employment which should be reflected in Canada with the appropriate time lag. But meanwhile, we have to assume that the biggest demand in Canada for professional sociologists and anthropologists will continue to come from the university sector.

* Ferriss, L.A. "Forecasting Supply and Demand of Sociologists," The American Sociologist, Vol. 3, 1968, pp. 228.

In a study of supply and demand for professional sociologists and anthropologists in Canada carried out in the summer of 1968,^{*} respondents were asked to project what they thought the demand for professional sociologists and anthropologists would be in specified future years. On the basis of these projections, we anticipate at least a doubling of the professional population of sociologists and anthropologists by 1974, the rate of growth then tapering off.

Our past and current dependence on graduate training programs outside of Canada can be seen in the fact that only 37% of those in our sample of professional sociologists and anthropologists in Canada received their highest degrees in Canada. No less than 50% received their highest degrees in the United States. The distribution of the professional population, according to where they received their highest degree will be seen in Table II. Evidence of attempts to reduce this independence for graduate training outside of Canada can be seen in the increase in Ph.D. programs in our universities. Where only four institutions offered the Ph.D. program in 1960, there are now eleven. The urgency of the need to develop substantial graduate programs of high quality in Canada, does not derive simply from the purpose of such programs to supply professional sociologists and anthropologists. Good graduate programs are also essential for the research enterprise, a point to which we return subsequently.

Mirroring this growth in significance and autonomy of sociology and anthropology in the academic domain has been the establishment of a separate association, of regional conference groups, the founding of periodicals, and a steep increase in the production of monographs, textbooks and books of readings, the contents of which are Canadian.

It has been indicated that by far the greatest amount of energy and time expended by anthropologists and sociologists on the Canadian scene goes into teaching and other academic activities. However, a large majority of them also carry on research, often labouring under considerable difficulty in combining teaching and research functions. The universities support directly the largest number of research projects (see Table III) providing

^{*} Demand and Supply for Anthropology and Sociology, Working paper prepared for Committee of Chairmen, Departments of Sociology and Anthropology in Ontario, August, 1968.

for graduate students and other assistants, and indirectly lowering teaching loads. However, there is a rather low limit to the extent of such assistance which most Canadian universities can afford to give or provide. In raising this limit, the universities need to be provided with additional funds for their graduate programs, for research stipends to staff and for the facilities we are required to provide, usually entirely at our own expense. Other problems associated with the research enterprise will be raised in the sections which follow.

B. Research Activities by the Federal Government

While the universities have been a major source of support and location for sociological and anthropological research, it should be noted that several federal government departments have had for some time well established research branches, the activities of some of which have been in the sociological and anthropological fields. We mention, as examples, the Dominion Bureau of Statistics, the Department of Indian Affairs and Northern Development, Labour, Manpower and Immigration, National Health and Welfare, Secretary of State, and others. The Senate Committee on Science will be receiving detailed information from such federal departments and agencies as to their role in sociological and anthropological research.

Some of the research carried out by governmental departments and agencies has been undertaken by full time employees of these departments and agencies. However, most of this research has been carried out by sociologists and anthropologists employed in the universities. Just about all of the best known professional sociologists and anthropologists in Canada, at one time or another, carried out research projects for some departments of the federal government, for crown corporations or quasi-governmental agencies, either as full-time employees, summer employees, on grants-in-aid, or on a contract basis. A list of some of the anthropologists and sociologists who have worked directly in connection with federal government departments and agencies is provided in Appendix II.

Because there has been a pressing need to make up for the serious backlog of sheer information about Canadian society, most of the research undertaken on behalf of these government departments and agencies has been of a descriptive and non-cumulative kind. The excessive concern to provide

information and material that would help orient administrators and policy makers in terms of their more or less immediate problems, has meant that the methodological and theoretical aspects of the social science enterprise have suffered by neglect in Canada. The component of support which should go towards building the theoretical and methodological underpinnings for research is not expected to be provided by federal government departments and agencies, except for the Canada Council. This matter is taken up in the next section.

For the kinds of research now being carried out on behalf of the federal departments and agencies, the Canadian Sociological and Anthropological Association does not feel a pressing need for some over-arching agency to channel the research endeavour in an overall manner.

Problems have been raised by researchers who complain that some federal agencies lack a realistic view of the possibilities, the limitations and contingencies, of social science research. However, there is some evidence to indicate that, as each department and agency gains in experience and clarifies its research goals, the linking of the federal demanders and the professional suppliers becomes smoother and more rational. Where this is the case, the quality of the research produced is quite high and the materials that much more useful. On the other hand, where a hit-and-miss and crisis approach has been used to get research carried out on behalf of federal government departments and agencies, the resulting research has been of very low quality and of little if any use to the agencies or to the social science enterprise.

In our opinion, less attention should be paid to creating a monolithic structure for all social science research on behalf of the government. Much more attention should be paid to providing top grade staff and consultants, trained in anthropology and sociology in the research branches who can define what is needed, who know how to go about getting what is needed and who are in touch with latest developments in the social science fields. Such staff members of research branches could link up with one another across branch lines in some informal committee structure to exchange information, plans, and ideas. Perhaps such a committee could link up directly with the learned societies concerned, or with a reformed social science research council.

C. Federal Assistance to Research

The marked dependence on the federal government for anthropological and sociological research shows up in Table III where it can be seen that of 464 applications for support between 1963 and 1968, 118 (25%) were directed to federal departments and agencies and 102 (22%) were directed to the Canada Council. University support was solicited in 126 (27%) of the cases. The tiny number (20) of applicants soliciting support from Canadian foundations reflects the negligible role of foundations in the anthropological and sociological research enterprise.

It should be stressed that the support for research from federal (including Canada Council) sources when compared with the support from the universities puts the former sources in a more favorable light than is deserved. As mentioned earlier--the universities pick up the tab for heavy concealed costs of overhead, facilities, student assistants and so on.

Some of the facilities required are very expensive to maintain. For instance, a small group research laboratory is not only expensive to set up and operate, but requires a substantial number of assistants, many of whom are in continuous employment, usually part-time. Laboratory facilities for certain branches of anthropology are also a considerable expense item to the universities. The costliness of computer and other data processing facilities hardly deserves mention, as it is so obvious. It should be standard practice for federal departments and agencies, as well as the Canada Council, to allow for the overhead costs to the universities of the research which is being carried out under federal auspices.

In the same connection, the federal government's support for graduate studies in the social sciences should not be as much dissociated as it is from the federal government support for research in the social sciences. The mutual interdependence between graduate programs and research is highlighted in the comments which sociologists and anthropologists were asked to make in a recent survey on research. A list of the chief problems encountered in carrying out sociological and anthropological research will be found in Table IV. In this table, it will be seen that the single item cited most frequently as a major difficulty in the way of sociological and anthropological research was the lack of trained research assistants. The

other items most frequently cited as obstacles had to do with amounts of funds available, particularly for long-term projects; the lack of alternative funding agencies and the excessive centralization of the fund granting process.

On the point about trained research assistants, we cannot stress too strongly the close link between the research enterprise and the existence of vigorous graduate programmes. Some agencies try to dissociate these two activities and visualize them as completely separate functions, to the extent, for instance, of insisting that the research assistants on a project do not use the material for a graduate thesis.

The interdependence between substantial graduate programs of quality and improvements in the quality and significance of research brings up the question of how to attract Canadian and non-Canadian graduate students of high calibre into Canadian universities. We believe that this should not be achieved by penalizing Canadians who want to complete their studies abroad, or by forcing graduate students who seek support for external study to argue why they so choose. We believe that positive steps to make graduate studies in Canadian universities attractive should concentrate on upgrading our graduate schools, on offering Research Fellowships with a higher value than the existing Doctoral Fellowships for those who decide to complete their studies in Canada, and on other positive inducements.

Because the provincial government, upon whose funds universities are acutely dependent, are almost exclusively concerned with the teaching aspect of academic programmes, they cannot be expected to provide the required funds to support the research aspect of the academic enterprise. Besides, good social science research has universal application, and is not significant only for the concerns of a given province. Somehow the pressure on graduate students and the rewards offered to them to act as teaching assistants, must be countered by an emphasis on training for research as well as on the importance of graduate students in the gathering and interpreting of data. That is, in anthropological and sociological research, the employment of graduate students is not simply undertaken to provide training for them, important as this is. Of even greater importance as far as the research is concerned, is the graduate student's role in gathering and interpreting data as part of a research team. To give an instance, in one national survey carried

out recently, no less than 20 graduate students were involved in carrying out community studies. Anthropologists are especially dependent on graduate students to collect the information they need, especially when this information is required from several different locations, within and outside of Canada. Archaeological field work would come to a standstill if it were not for the direct assistance provided by graduate students.

What is needed is a redefinition of the relationship between support for graduate studies programmes in sociology and anthropology, on the one hand, and support for the research enterprise in these disciplines, on the other hand. In the working out of this new relationship between programmes, the federal government has an especially important part to play.

A few other points in connection with research assistance need to be made. We must take into account that there are many institutions which do not have a Ph.D. programme in sociology or anthropology, or, indeed, which do not have any graduate programme in these disciplines. The desire of staff members in such institutions to conduct research, encourages them to push for the establishment of graduate programmes in their universities. It goes without saying, that we want to avoid the situation where just about every university has a Ph.D. programme in Anthropology and Sociology. But, at the same time, we do not want to discourage the people in places without a Ph.D. programme from doing significant research. Some provision must be made for this kind of situation. Finally, it should be noted that, even where graduate students are available to act as assistants in research, they are not always the most desirable people to handle certain aspects of the research jobs. Provision has to be made for technically trained people who are not going to complete the Ph.D. or even M.A. degrees who can be employed as full time research assistants. Again, because of the pressing concern of universities with the teaching function, these institutions cannot be expected to provide substantial support for the development and maintenance of such research assistance.

D. Structural Organization for Research

A number of associations have been formed, based on the learned societies divisions, during the past five years. They have emerged as a result of grass root pressure to recognize the individual needs of each

discipline or set of disciplines. Their emergence is the analogue, on the national scene, of the emergence of separate departments within universities. In any structuring at the national level of decision-making having to do with social science research support, it is imperative that these associations be intimately involved. At the same time, it should be recognized that the research function of these associations is not necessarily of central concern to them. Other groupings, such as Institutes and university departments, do not link in directly with these associations. These other groupings should also have a voice in decision-making about the disbursement of research funds and about selection of programs deserving federal support. In the case of university departments of anthropology and sociology, we believe that their representations should be channeled through our association. However, in the case of Institutes engaged in interdisciplinary programs, these should have direct access, independent of departments and learned society associations, to the levels where decisions are made about disbursement of funds and support for social science programs.

In Section C we spoke out against an over-arching structure of decision-making which would be concerned with research carried out on behalf of federal government departments and agencies. However, for the channeling of research funds (as distinct from agency-generated projects) to scholars in anthropology and sociology, it is recognized that some centralization is needed. Our concern is that the centralization leaves out of account the judgement of those people, particularly younger scholars, who are most sensitive to the changing challenges and requirements of each discipline.

The Canada Council is likely to continue as the primary source of funds for scholar-generated research. It should become even more clearly defined as the source of support for long-term projects, funded on a three-year basis. At present, advice as to the allocation of funds is canvassed among scholars picked by officers of the Council. We believe that, as far as anthropology and sociology are concerned, the only body which is representative of scholars in these fields, the CSAA should have a clearly defined consultation role in decisions about policy pertaining to research allocations.

As to the funding of social science research as a whole, this association should link up with others representing economists, geographers,

political scientists and so on, to discuss matters of mutual concern and to advise the government on the funding of social science research graduate programmes and related matters. From the interaction among officers of these associations there should emerge a consensus as to what kind of "umbrella" agency is most appropriate for social science. What is likely to result is a reformed Social Science Research Council with responsibility for the functions listed by Mabel Timlin in her recent study on the social sciences in Canada.

We would expect that whatever 'streaming' organization is established for the purpose of disbursing research funds, it should have the following characteristics:

- a) It should depend similarly on the advice of people in the disciplines pertaining to applications from scholars in those disciplines.
- b) It should be made primarily of people between the ages of 30 and 40.
- c) It should be composed of people who are not engaged primarily in applied research.

Special Committee

APPENDIX "A"TABLE IEmploying Agencies of Anthropologists and Sociologists

| | N = 494 |
|--|---------|
| University | 370 |
| Federal Government | 45 |
| Voluntary, Non-profit private organizations | 27 |
| Provincial Government | 23 |
| City/Municipal Government | 9 |
| Other and Blank | 20 |

Source: Marginals from responses to questionnaires of
Desmond Connor, 1967-68. Publication Forthcoming.

TABLE II

Where Earned Highest Degree

| | % | N = 494 |
|--------------------|------|---------|
| Atlantic Provinces | 0.8 | |
| Quebec and Ontario | 27.5 | |
| Western Provinces | 8.3 | |
| U.S.A. | 50.2 | |
| U.K. | 6.1 | |
| Other | 6.1 | |

Source: Desmond Connor "Directory of Sociologists and Anthropologists
in Canada", op. cit.

TABLE III

Agencies Solicited for Research Support
in Sociology and Anthropology 1964-68,
Canada

| <u>Agency Solicited</u> | <u>Number of Applicants N = 464</u> |
|---|-------------------------------------|
| University funds or agency | 126 |
| Federal Government Dept. or Agency | 118 |
| Canada Council | 102 |
| U.S. Agency | 39 |
| Provincial Gov't Dept. or Agency | 37 |
| Canadian Foundation | 20 |
| Social Science Research Council of Canada | 9 |
| Agencies Outside of Canada and U.S.A. | 6 |
| Other | 7 |

Source: Desmond Connor, op. cit.

TABLE IV

Chief Research Resources Deficiencies

| | |
|---|---------|
| | N = 494 |
| Lack Trained Research Assistants | 101 |
| Too Few Funding Agencies | 83 |
| Not enough funds | 73 |
| Lack Long Term Funds | 62 |
| Established professionals should have easier access to funds; decentralize fund granting, research funding uncertain, inadequate and slow. | 70 |

Source: Desmond Connor, op. cit.

APPENDIX B

Below are listed some of the Canadian anthropologists and sociologists who have carried out research projects for some departments of the federal government, for crown corporations or quasi-governmental agencies, either as a) full-time employees; b) summer employees: c) on grants-in-aid; or, d) on a contract basis:

Canada DBS - John Allingham, Y. Kasahara

Indian Affairs. Northern Development - Harry Hawthorn, Victor Valentine, Frank Vallee, William Willmot

Labour - Oswald Hall, Bruce A. McFarlane, John C. McDonald

Citizenship & Immigration - P. Pineo, F. Henry, J. Spencer, T. Grygier

National Health and Welfare - R. Goodacre, Freda Paltiel, W.Y. Wassef, Grace Anderson, Douglas Campbell, Kurt Johnasohn, John Spencer, Paul Geisel.

Forestry and Rural Development - D.R. Whyte, K. Cooke

Manpower & Immigration - R. Breton, Andre Robert, John C. McDonald

ARDA - K. Cooke, T. Philbrook, D.R. Whyte, D. Clairmont, M.A. Tremblay, G. Fortin

Agricultural Economics Research Council of Canada, M.A. Tremblay, Gerald Fortin, D.R. Whyte

Central Mortgage and Housing - C.E. Hopen, V. Valentine, F. Henry, P. Pineo

Canada Council on Urban and Regional Research - P. Pineo, R. Du Wors, Stewart Crysdale, N. Shulman

Canadian Broadcasting Corporation - Constance McFarlane, Eliette LeBlanc

Recent Royal Commissions

Health Services - B.R. Blishen, Oswald Hall, Bruce A. McFarlane, Donald Mills, Reg. A. Robson

Royal Commission on Bilingualism and Biculturalism - C. Beattie, Jacques Brazeau, Jean Burnet, C. Carisse, S.D. Clark, P. Coulombe, J. Desy, Jacques Dofny, Jacques Henripin, C.W. Hobart, S. Longstaff, P. Pineo, J. Porter, H.H. Potter, Marcel Rioux, Guy Rocher, George Torrance, Oswald Hall



First Session—Twenty-eighth Parliament
1968-69

THE SENATE OF CANADA
PROCEEDINGS
OF THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 58

TUESDAY, JUNE 10, 1969

WITNESSES:

Canadian Political Science Association: Professor Douglas V. Verney, President, Professor Henry Mayo, Past President, Mr. D. Kay. Member; Canadian Historical Association: Professor F. Ouellet, President; Humanities Research Council of Canada: Professor P. B. Waite, Chairman, Professor W. S. Rogers, Past President, Professor W. J. Waines, Executive Secretary; Classical Association of Canada: Professor C. M. Wells; Association of Canadian University Teachers of English: Dr. Roy Wiles, Past President; Canadian Council of Teachers of English: Professor Merron Chorny, Past President; Social Science Research Council of Canada: Professor of H. G. Thorburn, Past President.

APPENDICES:

- 123.—Brief submitted by the Canadian Political Science Association
- 124.—Brief submitted by the Canadian Historical Association
- 125.—Brief submitted by the Humanities Research Council of Canada
- 126.—Brief submitted by the Classical Association of Canada
- 127.—Brief submitted by the Association of Canadian University Teachers of English
- 128.—Brief submitted by the Canadian Council of Teachers of English

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

Aird
Belisle
Blois
Bourget
Cameron
Carter
Desruisseaux
Giguère

Grosart
Haig
Hays
Kinneear
Lamontagne
Lang
Leonard
McGrand

Nichol
O'Leary (*Carleton*)
Phillips (*Price*)
Robichaud
Sullivan
Thompson
Yuzyk

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,

The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.”

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate,

MINUTES OF PROCEEDINGS

TUESDAY, June 10, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 3.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Belisle, Blois, Carter, Grosart, Haig, Kinnear, Phillips (*Prince*), and Yuzyk—9.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*); Gilles Paquet, Director of Research (*Human Science*).

The following witnesses were heard:—

CANADIAN POLITICAL SCIENCE ASSOCIATION

Professor Douglas V. Verney, President

Professor Henry Mayo, Past President

Mr. D. Kay, Member.

CANADIAN HISTORICAL ASSOCIATION

Professor F. Ouellett, President.

HUMANITIES RESEARCH COUNCIL OF CANADA

Professor P. B. Waite, Chairman

Professor W. S. Rogers, Past President

Professor W. J. Waines, Executive Secretary.

CLASSICAL ASSOCIATION OF CANADA

Professor C. M. Wells.

ASSOCIATION OF CANADIAN UNIVERSITY TEACHERS OF ENGLISH

Dr. Roy Wiles, Past President.

CANADIAN COUNCIL OF TEACHERS OF ENGLISH

Professor Merron Chorny, Past President.

SOCIAL SCIENCE RESEARCH COUNCIL OF CANADA

Professor H. G. Thorburn, Past President.

The following are printed as Appendices:

No. 123—Brief submitted by the Canadian Political Science Association.

No. 124—Brief submitted by the Canadian Historical Association.

No. 125—Brief submitted by the Humanities Research Council of Canada.

No. 126—Brief submitted by the Classical Association of Canada.

No. 127—Brief submitted by the Association of Canadian University Teachers of English.

No. 128—Brief submitted by the Canadian Council of Teachers of English.

At 5.55 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Tuesday, June 10, 1969

The Special Committee on Science Policy met this day at 3 p.m.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Our guests this afternoon were with us this morning, so that I do not have to explain our procedure to them. Without further introduction I shall ask Professor Verney, President of the Canadian Political Science Association, to make his opening remarks.

Professor Douglas V. Verney, President, Canadian Political Science Association: Thank you, Mr. Chairman. I have with me today, Professor Mayo, Past President of the Association, and the author of the brief which you have. He will answer any questions regarding it.

I suppose members of the committee know that at this time of the year the societies elect new officers, and I have been in office only three days. If we seem a little less sure than you would have liked us to be this morning, that is because the Social Science Research Council was reorganized only on Sunday. A lot is expected to be done and, Mr. Chairman, if you had requested our attendance in three of six month's time I think you might have found us more satisfactory. I have come here knowing that I have a lot to learn, and indeed I learned a great deal this morning. I am very pleased with the new organization of the Social Science Research Council which, I think, members of the committee will find most helpful. In a sense I represent new developments. I do not have the memories of the old Canada when academics were very poor or claimed to be. I come from a new university and I suppose I speak, to some extent, from these developments, as well as others. I cannot, therefore, speak as an expert yet, but I think you should like to know the ways in which we probably will be coming forward with ideas.

There are three main concerns; first, centres of excellence. We heard this morning the motion of an institute for advanced studies. We, of course, would like that. We are not sure whether it is feasible in our system, and we are going to propose that each region in each field of political science come forward with proposals for research institutes. There are perhaps not more than six in number for the whole country. We notice that the argument for a data bank and a new agency for the new technological also involve research about six centres. Clearly we cannot afford to have everything we would like everywhere.

May I repeat what I said this morning, that there will soon be as many graduate students in Canada as there used to be undergraduates. We are just going to have to consider questions of cost. For instance, one proposal has been to consider as a start \$6 million as the sort of money which we should have. The Canada Council has said that this is too large a sum for them to consider, but if you had a cost analysis of my subject at the University of Toronto and at York University you would find that we are already spending \$1 million each, in total, for libraries, buildings, services, salaries and so on. We are now considering research, not on the past scale but on a future scale with research institutes in mind. Probably these institutes will be interdisciplinary for the social sciences, but somebody has to make a start and we think we might do that and call on other associations to join with us. Of course, many of these that we will be expected to will be of an applied nature, and surely our responsibility is to make sure that enough funds are available within the budget for the basic research which all academics cherish so much. Incidentally, in regard to basic research, people forget that this is often not too expensive. It is a matter of sitting and thinking hard.

Secondly, in addition to centres of excellence, we will consider links between universities, with 40, 50 or 60 more institutions from coast to coast. We have to consider the cost of

the new technology and the linking of one institution with another, such as has already begun to take place with television and libraries in Ontario. It would seem to us that only the federal Government can provide the leadership which is necessary if research costs are to be kept within reasonable bounds.

Thirdly, as the president of the association it is surely my responsibility not only to think of the big battalions, though I come from one myself, but to think of the small universities and their role in our society. We all know that our best students, as undergraduates, often prefer small institutions for very good reasons. There are good scholars there and we can, without much expense, make provision for these to come to the larger universities, if they wish, on sabbaticals for summer institutes and to have opportunities for travel, which may be greater than those larger institutions.

I am not sure that the Timlin Report accurately expresses the condition of the social sciences today. If you take Toronto alone it is not one of the world's centres for political science. I can think of only three universities, such as Paris, London, and Oxford, outside the United States, where there is a greater concentration and perhaps equal talent.

I am confident that in Toronto and probably other cities, such as Montreal and Ottawa, there will be the talent for world leadership. I might say that when I wrote to Miss Timlin in 1964 giving her my comments on research, as she requested, she wrote back and said that this was not the sort of reply she had expected, because we spoke with considerable confidence as to what was happening.

These three things are our concern, but I suppose you wish some concrete proposals of what we have in mind. Surely at this time, when parliamentary government is being considered, both in Ottawa and in the provinces, and the conference is meeting today in the city, we should be considering the future of Confederation. I am pleased to tell you that my association has been assisted by the Donner Foundation and by Members of Parliament in Ottawa who set up an internship program. This means that young people, not only political scientists, but future professors, will have training in the art of interpreting Parliament to the people. Perhaps the Right Honourable Mr. Trudeau will not have to complain that certain proposals of his Government have not been understood and have not been conveyed by the press. This has

been quite an expensive operation, but it is only the first of many which we hope will have to deal with public policy.

Similar institutes will be concerned with what goes on abroad. Many visits take place to other countries in order to learn from their experience, but how often is there duplication. How often do you, while on a committee, suddenly decide that you should not send someone to London, Stockholm or Paris without first having available the information as to who already knows something about the system. Already there are associations for Latin American, African and Asian studies. These associations of scholars will be assisted by the other social sciences in order to develop work which I know has been long hoped for in this country. In addition, we want to bring together associations such as the Canadian Institute for International Affairs and the Institute for Public Administration in Canada, which are modest research programs, and which are trivial to what this country can achieve.

I feel that I must make one statement which we have not considered, and that is in convection with the new wave of graduate students. We have to keep in touch with them. They have made some sharp and often justified criticisms of the way in which research has been directed in the last 20 years. If we are not careful in the social sciences we may stress science, because we can get money for it just as the Americans were able to obtain funds from the National Science Foundation, and then we may find ourselves criticized for pseudo science. Above all, we must consider that we are not training only professional political scientists, but we are surely educating the future leaders of this country and people with broader interests and with a capacity to examine as well as to advise. We are educating independent minds.

In a sense, the "Ivory Tower University" which we all knew in our youth, and which so many people think has passed away, is surely an institution we might well endeavour to preserve.

Finally, I should like to question one basic assumption which can be made in the United States, and that is that the impetus for change can come from below. There are far too many people in Canada who say it is not for us to provide the leadership—why don't you? There are 8,000 academic political scientists in the United States and 800 in Canada. Canada does need leadership and co-ordination.

We are pleased with these recent developments and we look forward to co-operation with the federal Government. I know how very astute people can be in politics, because Mr. Frederic Garner and Mr. Robert Winters have been among them.

If it is information you are requiring, proposals you wish to make or initiatives you should like to see from us, we would be very obliged to co-operate. I suspect that we need a crash program to get the social sciences off the ground. We need both vigour and economy. Above all, let us not forget that we are discussing expensive research which means that scientists need more. The humanities, in the final scheme of things, surely take pride and place, and the social scientists and the national scientists with the humanities must be considered equal partners in the academic life.

The Chairman: Thank you very much. Now, we will hear from the President of the Canadian Historical Association. I am impressed to introduce to you Professor Ouellet of Carleton University, who is also the author of a book of excellence on social and economic history of the Province of Quebec, dating from 1760 to 1850.

Professor F. Ouellet, President, Canadian Historical Association: Thank you, Mr. Chairman. I would like to emphasize a certain number of points which are raised in our brief. It seems to me that in order to understand the situation of the Canadian historian, it is necessary to consider that the historical profession has developed since the nineteenth century. At the end of the nineteenth century the first Departments of History were established and professional historians began to work in that field. They have worked around a conception of history which prevailed at that time. History was seen by most of them as narrative, as founded on the rules of historical criticism and as closer to literature. That current has been very strong among Canadian historians and is still strong. It seems to me that it will remain strong. Nevertheless, as in most other countries, the historical profession has begun to diversify and there is an increasing group of Canadian historians who admit that the traditional view of their craft is just partially valid. They consider that the main objective of the historian is to explain, and because he must explain the past, the Canadian historian is also led to use the techniques and the methods developed by other disciplines in the social sciences. They

think that the historian must also qualify. This is why in fact we have two main groups of historians: one that is considering that history is closer to the humanities, and the other that feels that history is just a social science.

I feel that it is very important to understand the future of the historical profession in Canada in terms of research. Because, if history is defined as social science, it seems that its problems in terms of research and of methods are closer to the problems of the sociologists, of the economists and of other social scientists.

I would like to insist on another point which seems to me very important. For most of the historians, whatever group they belong, a good archival organization is vital for the progress of the profession. After all, history is made with documents. It seems that all the problems are not solved in that respect. You have in most of the provinces archival institutions which sometimes are not very well organized. The Federal Archives have developed in order to meet the basic needs of the historical profession. Actually it seems that the relations between the governmental agencies producing documents and the Archives are very well established; but, at other levels, improvement is necessary. There is a need for a much more diversified program of publications—inventories of all sorts, editing of documents—a much more systematic program of acquisition of private papers. When I say private papers I do not mean only the papers of the political men, but also the papers of the business firms and the papers of various institutions. Economic and social history can't develop without that. This is why it must be done much more systematically in the future.

The last point I would like to raise relates to the development of research centres and of centres of documentation. In that field, there is a need for more specialization. Money should be provided to support these initiatives.

I think that Professor Waite wishes to add some comments with regard to our brief.

The Chairman: I suppose that Professor Waite is with us today in a kind of dual capacity since he is also the Chairman of the Humanities Research Council. If he should like to add to this brief and then continue on with his formal presentation for the Humanities Research Council of Canada, he is most welcome to do so.

Professor P. B. Waite, Chairman, Humanities Research Council of Canada: Thank you very much, Senator Lamontagne. This morning there was a confusion of time as to when the Canadian Historical Association was going to present its brief and comments. It struck me that this is extremely apt, because history does not fit either into one or the other; it is part of both disciplines, both humanities and social sciences. In my brief which I wrote last February and which was, incidentally, accepted by members of the Executive Council of the Canadian Historical Association, I tried to make it abundantly clear that history is a synthesizing discipline. You will remember this morning that Professor Kenneth Hare geographically synthesized the national and social sciences. I should like to suggest that history synthesizes the social sciences and humanities. We cannot avoid either one.

I tried to suggest in the brief, and I do not intend to repeat it here, what I think history is all about. The only point I should like to make is one which I think has been neglected by the Senate Committee on Science. It is that research does not necessarily produce good university teaching. It is commonly held that research and teaching go hand in hand, but often you find that a professor is hidden in his own research and research papers, and he would be far better off doing research on the lecture he is planning to give the next morning rather than the paper he is going to deliver at the Canadian Historical Association next June. I make that point in the brief also.

I should like to emphasize Monsieur Ouellet's point about the public Archives of Canada. I do not know of any archives anywhere, nor do I think that my colleagues know of any, that give better and more comprehensive service than the Archives on Wellington Street here in Ottawa. It is a superb institution. It can obviously be improved and it may need more space and to be separated eventually from the National Library, but certainly it affords a great service to us and we should certainly like to see it supported and developed.

I should also like to make brief mention of the Historical Sites and Monuments Board which the historical profession feels is very important. Its work is ramifying at a geometric rate, particularly with the preservation of architectural buildings and street scapes and the whole texture of urban life as it once was.

Finally, I feel that the dispelling of the myth is particularly important and peculiarly

relevant to Canada. It is abundantly demonstrated in Monsieur Ouellet's book. There are a number of myths, some associated with Monsieur Riel. I feel that it is the duty of our historians to unmake myths and write the truth. As a famous German historian once said:

Geschichte wie es eigentlich gewesen.

History as it really was. I think my colleagues ascribe to that and I certainly do myself.

I have not said anything about the various problems of government support of research. I have made that abundantly clear in the brief, and I do not need to repeat it here. There are a variety of aims. The only point I have missed and one point that I should like to emphasize is how much the Canada Council has meant to us. We should naturally like to have more funds available, but we have no real quarrel with the way it operates. We just like to have broader support for the work of the council.

That is all I have to say, Mr. Chairman, on behalf of the Canadian Historical Association.

I am also here in the role of Chairman for the Humanities Research Council, seconded by the Past Chairman, of the Humanities Research Council, Professor William Rogers of the University of Toronto. Incidentally, Professor Wiles, who is speaking for the Association of Canadian University Teachers of English, is also a past president of the Humanities Research Council of Canada. Their expertise in this matter is probably more complete than mine.

The Humanities Research Council is a body analogous to the Social Science Research Council. It covers, in humanities, roughly the same ground that the Social Science Research Council does for the social sciences. It represents, at the present time, as does the Social Science Research Council, nearly all of the learned societies in the area of the humanities, that is, in classics, philosophy, French literature, English literature, religious studies, and English. We, too, like the Social Science Research Council, have had some of our powers shorn away from us by the growth and development of the Canada Council. We have now reached a point where we feel that our work, in acting as a co-ordinating body for the learned societies, is at least as important as our subsidizing of publication of books. We act as a kind of umbrella for the learned societies in dealings with the Canada

Council and in persuading that body of the virtues of certain projects.

Again, speaking on behalf of the Humanities Research Council, I should like to emphasize how much we are grateful to the Canada Council without which the humanities in Canada would be far more naked in the face of the world than either the natural sciences, medical sciences, medical sciences or the social sciences.

The support of humanities is distinctly lower at a government level than any of the others, for reasons that perhaps can be related to the nature of contemporary life. If you establish the fact that the basic problems of contemporary life are philosophical—philosophical in that broad sense—surely humanities deserve far more support than they presently get. I should like to see parity between the humanities, social sciences, natural sciences and medical sciences on the Science Council.

My colleagues may have some further comments to add to what I have briefly suggested. I feel that Professor Rogers and Professor Wiles may have some points to make or some that I have not made sufficiently clear.

The Chairman: Perhaps this might wait until we reach the discussion period, unless there is something specific to be raised.

Professor C. M. Wells is a member and is representing the Classical Association of Canada.

Professor C. M. Wells (Classical Association of Canada): I should like to quote from page 3 of this brief that was presented by the Classical Association of Canada:

The study of Classics as understood in Canadian universities embraces the interests of all humanities and of many disciplines outside, in that in addition to the literature of Greece and Rome, the classicists may be interested in problems of history, anthropology, architecture, philosophy, art and archaeology.

I would like to emphasize this, because I am aware:

[Translation]

Perhaps I should point out to the French-speaking members of the Committee that I am well aware that, especially in Quebec universities, departments of ancient studies are only interested in classical languages, in Latin and Greek languages and literatures, and that it is mostly because of English tradition that

the department of ancient studies is interested in the Greco-Latin society as a whole; and that it is only because of this tradition, which is also beginning to take hold in French universities—particularly here at the University of Ottawa—that ancient studies can claim, as the Canadian Historical Association has just pointed out, to be a discipline where the humanities and the social sciences are linked up.

[Texte]

This is exactly the same claim that the Canadian Historical Association has made.

The Chairman: We may have too many umbrellas at the end.

Dr. Wells: They serve as a tie between the two. The only difference is that we are a little more removed perhaps than the other historians.

Dr. Waite: All generations are equidistant from eternity.

Dr. Wells: Without going into details, the brief of the Association contains eight main requests, all of them, unfortunately, for more money. These could be lumped together under three headings: More money for books, for the purchase of books for libraries and for the subvention of publications; more money for travel, particularly travel funds to enable scholars to attend learned meetings and travel funds to enable research seminars to be held, something that is particularly important in a discipline the number of whose members across Canada is not large; thirdly, one which I have to admit is close to my own heart and which I think is very relevant, more funds for archaeology in its many forms, for the purchase of archaeological material by the universities, for the establishment of national centres in Athens and Rome and for the development of archaeological training for classical scholars abroad.

We are as an association extremely happy with the work the Canada Council has done. We would like as an association to express the wish that the Canada Council may be strengthened and spared to us to continue with its work.

Dr. Waite: Hear hear.

Dr. Wells: And again the wish that it may be provided with still more funds than it has been.

The Chairman: Thank you very much. Now, at last, Dr. Wiles, who is representing here today the Association of Canadian University Teachers of English.

Dr. Roy Wiles, Association of Canadian University Teachers of English: Thank you, Mr. Chairman. I am very happy to be here. I represent the Association, though I am not its president; I was once its president.

Dr. Bevan, the president of the Association this year, is engaged in the meetings in the University of York, where the annual meeting of the society is taking place.

Perhaps there is a certain appropriateness in my being here, since it was I who, at Dr. Bevan's request, wrote the brief, the text of which I assume the members of the committee have already seen.

I take it, Mr. Chairman, that my function is not to add substantially to the brief, nor to summarize it, but to direct attention to two or three elements in it.

First of all, the gratification of the Association of Canadian University Teachers of English that that association and its basic interests have been regarded by this committee as properly falling within the scope of its concerns. Our activity is, we think, respectable in the realm of scholarly intellectual operations. What we do is ultimately for the benefit of Canadians at home and the reputation of Canada at home and abroad.

Our work we think serves to stimulate students in classrooms and to contribute also to the world's knowledge of literature in English.

I should like to emphasize particularly the fact that our range of research interests goes beyond the national boundaries. Our research is directed toward non-Canadian as well as toward Canadian drama, poetry, fiction, etcetera, toward the total of the rich heritage from the past and indeed the richness of the present contributions by creative poets and dramatists who write in English.

I think I need not argue that our discipline deserves attention. The brief submitted by the Humanities Research Council in a sense serves as a kind of umbrella brief representing the various disciplines, of which English is, of course, just one.

This is my opportunity to express, as others have, the deep appreciation of the Association of Canadian University Teachers of English for the services, the encourage-

ment, financial support, et cetera, provided by the Humanities Research Council and by the Canada Council. It is the hope, the confident hope of members of the association that these two bodies will continue to function with greater and greater financial resources.

Having set forth details about the opportunities for research in our particular discipline, the brief proceeds to enumerate a few specific needs. It is pretty obvious that for research in English literature and, indeed, in the English language, though another association will present views concerning the necessity to support research in linguistics, we obviously must have the basic materials for research.

In literary studies those basic materials, as has already been suggested by those present, Mr. Chairman, are books or reasonable facsimiles thereof, microfilm, microfiche or Xerox copies.

May I emphasize that our concern is not merely that the libraries of this vast country should be adequately provided with the publications that are coming from presses all over the world today. Even more importantly, we should be provided with the basic texts of research.

Early in the brief reference was made to the plain fact that research in English literature has not yet solved all the problems. It is necessary for us to have the basic texts. Not all the work has yet been done on old English, or mediaeval literature, upon Elizabethan and so on through. In order for reputable, respectable research to be done, research that will result in positive contributions to the world's knowledge of a great literary heritage, we must have available all the texts. These are increasingly difficult to procure and increasingly expensive. The sooner the better, therefore, Mr. Chairman, massive increases in library holdings should be provided at expense which will be very considerable.

We are aware of this. We think in addition to funds for mechanical aids, including computer time, of course, and certain other time-saving aids to research, the free time which university research people must have rather than accepting at whatever stipends teaching responsibilities during the summer, it is very necessary, imperative indeed, Mr. Chairman, for very substantial increases to be found for the purchase of library materials.

This is a matter which others have already emphasized and I am not prepared to state

figures. Let it be recognized, as others have already suggested, that there is no sound reason for looking upon the humanities as a group, or studies in English as one member of the group as deserving of the very, very modest support which thus far we have received.

Surely a fair view of these groups of disciplines would lead to recognition that in this prosperous, progressive and wealthy country money ought to be found for the basic research materials in the study of English literature, money comparable to that in any other of the numerous disciplines in the academic world.

Mr. Chairman, I shall not go into further detail. I will do my best to answer questions in support of statements made in this brief, or made by myself.

The Chairman: Thank you, Dr. Wiles. Now, finally, Professor Chorny, who is the past president of the Canadian Council of Teachers of English.

Professor Merron Chorny, Past President, the Canadian Council of English: Mr. Chairman and gentlemen: Besides being past president of the Canadian Council of Teachers of English I am a Professor of English Education at the University of Calgary.

I speak to you as a person who has taught English in Canada for twenty years in elementary school, secondary school and university, a period interrupted by service in the RCAF, during the second world war and by formal study.

I have been fortunate in gaining experience about the teaching of English in other countries through such opportunities as currently serving as Director-at-Large of the National Council of Teachers of English in the United States. I am chairman of the International Steering Committee for English, a liaison body involving representatives of professional English associations in Great Britain, the United States and Canada.

I say this not to impress; I say it in modesty. I say it because it may indicate some of my concern for the teaching of English. My interest in English, incidentally, does not start until I was about three or four years old. Although I had learned how to speak English by the time I started school, my first language was Ukrainian, my parents having come to this country about 1910.

Today I speak for the Canadian Council of Teachers of English. I appreciate this opportunity to appear before the Senate Special Committee on Science Policy in support of the brief which our association has submitted. CCTE is a young organization, having been formed only in August, 1967. The comments which my colleagues made earlier bring painfully home the situation of attempting to improve something that I believe is important without adequate means.

The object of the Council is to engage in various kinds of activities in order to improve the quality of instruction in English at all educational levels in Canada. Membership in the council is open to all persons engaged in the teaching and supervision of English at any school level and to all others interested in the improvement of such teaching.

That CCTE is already becoming a truly representative body is evident in the fact that its membership, now numbering nearly 800, embraces teachers of English from every province and from school levels ranging from kindergarten through university.

Since its inception, the council has established two publications, a newsletter and a magazine. Two issues of each will appear this year. By 1971, both newsletter and magazine will be published quarterly. The first annual conference of CCTE, held in Calgary last August, drew 560 teachers of English from every province in Canada, from 20 states and from Great Britain.

I mention these facts because they indicate that the Canadian Council of Teachers of English is meeting a long-felt need in this country.

The brief submitted by CCTE is concerned with English as language and, in this context, as one of the two main languages of instruction and study in Canadian schools. Further, this concern with English is not simply with the matter of whether one says who or whom or where one places a comma, but with language as the means by which human beings think, know, understand and communicate their thoughts and their feelings.

In this sense, English would seem to be of concern in the formulation of a national science policy. First, the success of a science policy in any country is fundamentally dependent upon the language proficiency of all who are directly affected by that policy.

Whether the objectives of that policy are realized will be determined largely by the

extent to which the persons involved are articulate in speech and writing and competent in reading and listening.

Second, English as a language of instruction in our schools is fundamental to learning. If a student cannot read accurately and write coherently, he is unlikely to progress very far in science or mathematics, or in any other subject for that matter.

Third, a national science policy is concerned with the economic resources of a nation, and education is a factor in economic growth. The extent to which the stock of education is increased in Canada will be dependent on the quality of English instruction in the nation's schools.

Fourth, a national science policy is also concerned with the human resources of a nation. It requires citizens who can think critically and imaginatively, who are articulate and sensitive in their communication and who have the ability to view scientific activity against a broad background of human endeavour and human aspirations.

In the development of social and humanistic values English in the schools plays a vital role.

In the light of the fundamental importance of English to the various aspects of scientific activity, it is important that a national science policy reflect a concern for the continued improvement of the teaching of English in the nation's schools and facilitate action for such improvement. To say that the task can be left to other jurisdictions is to underestimate the nature of the undertaking. First, action is necessary now. It is unlikely that other jurisdictions will react with the urgency that is needed.

Second, the scope of the undertaking would exceed the capability of any single jurisdiction.

Third, uncoordinated regional action would be uneconomical and inefficient.

Fourth, the problem of English, again one of two languages in this country, is a national problem. It requires national leadership with provincial cooperation towards a solution.

Against this background the Canadian Council of Teachers of English presents certain recommendations, constituting a program of action which is put forward as the most ready means of making the greatest advance for improving the teaching of English in Canada.

I want to make clear that CCTE is not saying that the teaching of English in this country is going to the dogs; however, the gap between what is now being done and what might be done with even a limited amount of additional support is so great as to cause serious concern. Our request is for the means of making improvement possible. We have tried in our brief to document some of the situations which we believe indicate the need for greater effort to improve the teaching of English.

Let me now briefly summarize the recommendations which we make:

First, that federal support be provided for a survey of the state of the teaching of English in Canada. This survey would provide data for identifying the most urgent problems and would provide guidelines for intelligent action.

Second, that federal support be provided for a national conference to determine new directions for the teaching of English in Canada.

Present developments in practice do promise revolutionary changes in English, perhaps equal to some of those taking place in the mathematics and the sciences. The proposed conference would consider new developments in terms of which it would establish guidelines that could be used for developing new programs in English and improving the instruction in English within and by the existing jurisdictions.

However, this recommendation should not be misinterpreted as proposing a national curriculum in English.

Third, that federal support be provided for a program of in-service institutes to improve the teaching of English. Here is a pilot program of five institutes to be modified and expanded later in the light of action taken on recommendations one and two to improve the competence of teachers of English.

The institutes it is proposed would be conducted and offered by Canadian universities.

Four, that the federal government establish a foundation to support research in the teaching of English. At the present time funds for research in the teaching of English and education generally are very, very limited and in any program of improvement a parallel program of research is vital.

Fifth, that federal grants in aid of travel to attend professional meetings and to partici-

pate in exchange programs be made available to professors involved in English education and to selected teachers of English in Canada.

If we are going to break down the isolation, the lack of communication, the insularity which has contributed to our present situation, then some provision of this type will need to be made.

Finally, echoing a recommendation that has been made by other colleagues here, that federal support be provided for the establishment of a national information retrieval centre for English. Such a provision would help to preclude the possibility of continued isolation regarding this area with its present consequent conditions of heredity and lack of change.

The Canadian Council of Teachers of English makes these recommendations neither to promote private selfish motives nor to facilitate the activities of a special interest group. It speaks, neither on behalf of its members nor of the many teachers who are not affiliated with our organization; its concern is the children of this country.

Certainly a national science policy must encompass the aim of improving the lot of all citizens in Canada and of increasing the opportunities of all children in this country for a better life. We are convinced that teachers of English, provided they are given the means, can make a significant contribution to this effort.

The Chairman: Thank you very much. Now that we have an official interpreter there in the box I would propose that we have the discussion period in French, because we have I suppose also to support the teachers of French in this committee.

Senator Carter: Mr. Chairman, first of all I must say how sorry I am that I was not here this morning; I was not able to be present because I was attending another committee.

It is interesting I think that the briefs we have before us today fall into two groups: One group deals with specific subjects, political science, history, English; then we have the group sciences, the humanities and the social sciences. Within that it strikes me as I read them all that they practically all say the same thing, some in fewer words than others. They all seem to say that the quality of teaching is poor, at least could be much better, that libraries in Canada are well below par, that there should be travel grants to enable professionals to meet, travel around

and exchange ideas, that there should be more money for travel, more money for research. All of this seems to imply that these ills which are enumerated are the result of bad decision-making somewhere.

Then, they all go on to imply that if only they had a private pipeline to the policy maker matters would be a lot better. They seem to imply also that the present mechanism, the Canada Council, is not too adequate.

The first question I would like to ask is what kind of mechanism do you envisage to give effect to your ideas? Obviously you should have some way of coming to some consensus among yourselves and speaking with one voice instead of everybody saying the same thing with different voices?

What kind of mechanism do you envisage to get better decision-making, better policy-making? What changes would you make in the present set up to bring that about?

The Chairman: Who wants to have a crack at that one to start with?

Professor Henry Mayo, Past President, The Canadian Political Science Association: I am a past president of the Political Science Association and I helped to draft this brief. That is why I am here today, Mr. Chairman.

As you know, the question raised by Senator Carter was in fact raised this morning, so I will make only a brief comment upon it.

In a way I feel slightly apologetic that our association, of all associations, did not see fit to undertake a study of the mechanisms. You would expect political science to do this, I think if you expect anybody.

Senator Grosart is only too painfully aware of the gap that we have left here. I think we looked at it like this: First of all, so far as the distribution of federal research funds is concerned, at least among the social sciences and I think this perhaps applies to the humanities as well, as far as the actual distribution of the amounts of money is concerned, we have nothing particularly critical or new to say.

On the whole we are reasonably happy that the Canada Council has devised this mechanism which *de facto* anyway has separated the performing arts on one side from the social sciences and the humanities on the other.

Although this is the main distribution of federal research funds for these subjects,

there are, of course, immense amounts spent in other ways by the federal government. This gives scholars access to money, whether it is through CMHC or a dozen and one federal departments and agencies. On that side of it we really have not anything new to say.

On the other side we did some thinking; we did not say to anyone, "now, you work out for us the kind of mechanism which we can bring forward to the Senate Committee in our brief." We went as far as thinking about it like this: In one sense we know that the amounts of money available are certainly going to be determined by the political process. The government is still going to decide whether it picks its advisers, as with the Science Council for example, or whether it sits back and is the focus of various lobbies, groups and so on.

It could be the Humanities Research Council; it could be the Social Science Research Council speaking with various voices to government.

In the end there is no getting away from that political decision. We did not feel confident enough about suggesting any structure for the social sciences and the humanities comparable to the Science Council of Canada, so we just did not work that out, Senator Carter. What we did see quite clearly is that the requests or what I think Senator Grosart called the in-put into the political process is quite clear, that we are going to act jointly as kind of pressure groups.

I do not think that there ever will be a way of escaping that.

Senator Carter: The point is whether you are a pressure group within your own circle, within social sciences or within the humanities or whether you are a pressure group on the government.

Professor Mayo: I meant on the government, sir, because after all we are talking about the federal government as a great source of research funds.

The Social Science Research Council and the Humanities Research Council at the moment act largely in other ways. It is the role of the Canada Council to act and ask for more money and we were slightly dubious about that.

The other role, the distribution role of the Canada Council, is not something that we have doubts about. We all come before you, Mr. Chairman, and say above all more

money. We should say this because in the past we have been a less affluent society. Now that we are a more affluent society and want to be a civilized society as well as an affluent one, we are going to have to spend a lot more money on the social sciences as well as on the natural sciences. This I take it is a mark of a civilized nation.

So the pressures will build up but, Mr. Chairman, there is no way in which I can see at the moment that there is any preferred mechanism.

Professor Verney: I would like to speak with regard to the speed of developments of the last few weeks. These reports came out at the beginning of May. Within days I was called to Ottawa; the Association of Universities and Colleges of Canada got the humanists and the social scientists together to discuss it. I interviewed Professor Dupre, who is a political scientist, and made positive proposals for a new organization in this document. I met the Canada Council representative.

In the last seven days we have reorganized the Humanities and Social Science Research Council and my guess is that there will be now the chairman of the Humanities Council, Professor Waite, who is here, the chairman of the Social Science Council, Dean Dube, who was here this morning. They have the presidents of the other societies who have been here this morning and this afternoon. There is clearly building up the sort of organization which I am sure you have expected to find and wondered whether it was coming; it is coming, very soon.

Senator Yuzyk: Could I ask about this organization, because we are very much concerned, of course, in efficiency and effective instruments.

The fact that the two historians that we have here today were talking about history being classified as a social science or a humanity shows that a historian, at least, would want the full cooperation of these two bodies.

Is there cooperation between the Humanities Research Council and the Social Science Research Council?

Professor Waite: I would say very much so. The Chairman of the Humanities Research Council is ex officio on the Social Science Research Council and vice versa. They have a joint secretariat and know precisely what each other is doing.

There may come a time, perhaps not too long in the future, when there may be full parleys about an actual joining of the two councils. I cannot speak to that at the moment, but there is no doubt that they know what each other does. Each one represents the learned societies of its own area.

Senator Yuzyk: If these two councils did join, would they still be associated with the Canada Council, or would you like to see a body that would represent all of social science disciplines as well as the humanities?

Professor Waite: To make perhaps a closer union may not be necessary, Mr. Senator. They work pretty well as they stand. I think the point about it is that these are really parliaments of the learned societies. Each parliament of the learned societies can act as a kind of forum in discussions with Canada Council.

We see Canada Council as a bridge between ourselves and the government, rather than substituting for Canada Council.

We can do certain things that Canada Council may not find it very convenient to do. We administer travel grants to the learned societies for Canada Council. We act in some senses as a kind of Canadian association of learned societies. Nevertheless, we ourselves are not really equipped at the moment, although again I would defer to my colleagues here, to do the things that Canada Council does and does in my personal view superbly well.

Senator Yuzyk: Are you satisfied with the funds that are coming in for the purposes of research in history, for example?

Professor Waite: When I say the job I echo the point that Professor Mayo made. It functions fairly well in terms of the funds it gets.

The Chairman: The division of the pie is good, but the pie is not big enough?

Professor Waite: I agree that there are some complaints from some of the social scientists that they feel they need desperately more money. If I can take a point that was made by Jean Boucher the other day, that the joint funds available for research of the Medical Research Council and the National Research Council amount to approximately a hundred million, the equivalent that Canada Council has available is 22 million for the humanities, social sciences and the arts.

The disparity is monumental. This is the reason why a lot of us are here today.

Senator Yuzyk: It is obvious, then, that Canada Council is not having the effect upon the government that you would like it to have, since the Canada Council is really not an advisory body for the government. Do the societies in humanities and social sciences request some kind of a body to have an advisory role for the government?

Professor Waite: I would suppose that Canada Council has functioned for the humanities and social sciences in that respect. We expect that Canada Council is able to appeal to the government for funds but, obviously, its effect has not been what we would have liked.

Senator Yuzyk: We cannot see it here, because if you compare the Canada Council with the Science Council of Canada, the Science Council does produce reports that deal with policy. It may be long range policy, but still dealing with policy in the natural sciences.

We do not have an equivalent body dealing with social sciences and the humanities that can bring out reports.

The Canada Council does not publish reports of the needs in any of these fields, so it is up to the societies that are represented here to make their needs known. Yet, because of the fact that there are so many societies and you still have not achieved the coordination that is necessary to increase the effectiveness of your voice in government policy-making, this has not been done. This is what I am asking about.

One of the briefs deals with science, that is deriving science from the original word, the Greek word means of knowledge. In this case science as known, the modern term of science, does not have monopoly in the field of knowledge. It only has monopoly, shall we say, in the field of natural and physical sciences. Yet there is much more attention being paid to the natural sciences from the point of view of funding as far as the government is concerned than the social sciences. Yet the scientists themselves, the natural scientists, have stated that it is necessary to have the cooperation of the social sciences for the progress of society here in Canada and the progress of humanity.

In the brief from the Humanities Research Council there is a statement that a revised or

a re-shaped science council will not satisfy the needs of the social scientists and the humanists. Then what would the social scientists and the humanists like to see in place of the Science Council? What form or mechanism, as Senator Carter referred to it, is required to make your views known to government?

Professor Waite: Rather than pre-empting the discussion, Senator, I should defer to two colleagues, a past president of the Humanities Research Council and a past president of the Social Sciences Research Council, both of whom might have something more relevant to say.

Professor W.S. Rogers, Past President, Humanities Research Council of Canada: The point is very well taken. It represents a new phase in the development of the two research councils. This is what we will have to address our attention to in the immediate future.

One thing should be borne in mind, that is that this is a role which the councils have played quite significantly in the past. In fact twelve years ago, thirteen years ago I suppose it is now, at the time of the Massey commission the two research councils played a quite important role in insisting on the need for the Canada Council.

I do not think we can underestimate the tremendous help and the tremendous growth of that council in the last three or four years. The figures have gone up quite dramatically. They have not met the needs and if they do not go up even more dramatically they will fall behind other segments of the scholarly community.

The machinery is there to a certain extent for the increase to our constituency through the Canada Council, which is already administering, as you suggest, what it has extremely well.

There is one point that I think should be made, since it has been made in other contexts. That is that when we speak of increased funds for the Canada Council I think we are thinking chiefly of the buying of free time for scholars, the travel of scholars from one place to another, the publication of the fruits of their research and this sort of thing, which are proper problems for the Canada Council at the moment.

I do not think that this kind of increase in funds to the Canada Council will begin to meet the need for library resources, which is of quite a different scale. The figures men-

tioned vary from a hundred million to 150 million in the next ten years.

I do not think the Canada Council is particularly anxious to take that on as its function, but I do think that this must not be lost sight of when we are planning to ask for more funds.

This is a very specific need which will have to come in some other way.

The councils, each of which are autonomous bodies, do work together, as Dr. Waite suggested, through a joint executive, a joint secretariat and common meetings. I do think that the proposal which is under active discussion at the moment with the Canada Council for a secretariat which will function in the interests of all the learned societies—there has been an impressive feasibility study made on this, material has been sent out to the learned societies to get their reactions on this—will be evolving in the very immediate future.

I think it will be much more possible for us to speak with one voice rather than with a chorus of voices to the same ends in a more effective way.

The Chairman: There is still lack of communication it seems to me. We had the Royal Society before us. They want now to have more money to provide exactly this kind of secretariat service for the learned societies that you are asking of us. There is some kind of parallelism here that still remains I am sure for most of the members of this committee, mysterious.

Senator Carter: Mr. Chairman, along that line, when we had the scientists, chemical engineers, the civil engineers and all these biologists, micro-biologists and all these, the evidence that we got indicated that each one was working away in his own little corner and was preoccupied so much with what he was doing in his own field that he was almost oblivious to the other fields to which he was related.

I am wondering whether the same thing is not happening here in history, English, political science, whatever you want. Everybody is concentrating so hard on his own needs, he is so preoccupied with his own field, his own subject or research that you are not thinking as a group.

Because you are not thinking as a group you are not generating the kind of overall

pressure that is needed so that each one sees himself in relation to the other.

Dr. Wiles: Now if I may, Mr. Chairman, I would like to say two or three things that are related to the things that have been mentioned in the last few minutes:

One, that before the Canada Council came into existence the Social Science Research Council and certainly the Humanities Research Council had to go across the international border to get money to do the things which subsequently Canada Council has been able to do and to do very well. It was shameful really that that should have been necessary, but funds were simply not available.

Now, funds in recent years, the last dozen years, have been available at increasing amounts but are still woefully inadequate, most certainly for the provision of adequate libraries, or facilities for research.

I am not prepared at the moment to cite specific figures that are required for the acquisition of an accelerator for an atomic reactor. These things are absolutely indispensable for advanced research in the natural and physical sciences. I should not for the moment suggest that that is money improperly spent. It does seem to me though that there is a shocking disparity between this comparatively liberal support of research in the physical and natural sciences and the most woefully inadequate support for the provision of facilities for research. I speak now for research in the humanities.

Another point that was questioned earlier was the readiness of the Social Science Research Council and the Humanities Research Council to collaborate. Not only have we a joint secretariat, much to our mutual advantage, but in the past we have on occasion joined to present joint briefs to Canada Council for a series of projects that required financial support. For years now there have been informal conversations about the possibility of actual combination. As Dr. Waite suggested, that may not be necessary. We are collaborating very well, particularly since in the last two or three years the two councils are more truly representative of these individual societies and associations which the Senator has just asked about.

Increasingly, let me confine my observations to the Humanities Research Council, the membership of the Council comes directly by election of the individual representatives of the several, some ten or a dozen separate

corporate bodies, students of philosophy, investigators of philosophy, French literature, history and English. So that the Humanities Research Council, much more truly now than it ever had in earlier years, can serve not only as umbrella but as spokesman to the Canada Council or whatever other body may be established to speak to government representing the increasing and very significant requirements for financial support. That is particularly so in this large scale matter of libraries.

Now, I cannot, of course, speak for Canada Council, but I suspect that Professor Rogers is right in suggesting that the Canada Council is now reluctant to undertake this massive project of getting books into the libraries, where our Canadian students, graduate students and professors are engaged in the main in their research. It is quite clear, Mr. Chairman, that for some projects of research there is no library in North America that is adequate. For certain materials one must go abroad and, of course, it is the contention of the Association of University Professors of English that funds should be available. Funds should also be available for attendance at seminars, which are very stimulating, for consulting fellows in their own field, but mainly our contention is that money must be provided for a tremendous increase in library holdings.

I do not mean, Mr. Chairman, one library. This is a vast country. It would be quite improper to suppose that any large concentration of the important research materials in one place would serve this vast community, which is increasing very rapidly.

We refer to bibliographical centres for obtaining information on what is available, this kind of thing. Funds for the preparation of annual bibliographies has already been suggested and the suggestion may well be implemented.

All of this will surely best be done by strengthening the present Canada Council or its office as distributor of funds and as spokesman to government. It should represent not only the continuing and increasing requirements for research in all the humanities, not just English, but also very particularly this other matter, much greater it seems to me in the financial necessities, of providing adequate libraries.

It seems to me, Mr. Chairman, therefore, that there is no fault whatever to find with

the functioning of the Canada Council. It is a complaint about the inadequacies of the funds which it has been administering.

Senator Yuzyk: It would indicate from what you have stated now that Canada Council has not made strong enough representations to the government for libraries and library services.

I am now not taking into account the national library and the archives but, as you have stated, in our universities right across the land, in our educational institutions.

Dr. Wiles: Mr. Chairman, I think that is fair enough, except that it may well be part of the responsibility of the Humanities Research Council and its components on their part. They have not thus far so forcefully advocated a very considerable increase in the allowances for building libraries.

I would be sorry if I went on record as condemning the Canada Council for inattentiveness to a crying need.

The Chairman: Before Professor Wainess makes his comments I would like to suggest a question to him in the sense that I was several years ago, I hesitate to say many years ago, a member of the Social Research Council.

At that time, of course, that council was almost exclusively a granting institution. It seems to me that as a result of creation of the Canada Council the two private councils took a lot of time to readjust and to redefine a function of their own.

Professor W. J. Wainess (Executive Secretary, Humanities Research Council of Canada): I think, Mr. Chairman, that is quite fair. You and I were on the council at the same time probably and what you say is quite true.

The Chairman: That makes you ineligible to the Senate.

Professor Wainess: I think it is only now that the new directions which the councils have wanted to take for some time are becoming feasible or possible. Senator Yuzyk's question, in part at any rate, has been dealt with fairly fully by Professor Wiles. I just want to add that I think we must stress again, as was stressed this morning by Professor Rogers, that the two councils now represent the learned societies much better than they ever have before.

The very fact which Senator Yuzyk has commented on, that we have spoken with many voices here and we have all said about

the same thing, is evidence that the learned societies, not only the social sciences on the one hand and the humanities on the other, but the two groups are coming closer together in their thinking.

I suppose the greater recognition of the importance of research in the universities is one of the factors that is doing that.

I want to emphasize that point that at this same time they are coming together and that the two councils, as Professor Rogers says, have worked together for years. Their executives have met jointly. They meet jointly regularly. Some of their projects are joint projects. For example, the Centenary History of Canada, which is edited by Professor Martin, is a joint project of the two councils, and so on.

The assistance which has been given to scholars now for the last five years to get them to international conferences is a joint project. This is financed by money which the councils jointly applied to the Ford Foundation for and obtained over five years ago.

Professor Wiles has dealt in detail with these matters and I will say no more. The other point which was made this morning and has been made this afternoon is with respect to this advisory function. I think it was Senator Grosart this morning who asked the question.

There are these elements at the government level, the general advisory function and the granting function. The councils come in here and will come in more and more I am sure, as lobbies to the government, and to whatever advisory body is set up.

I think it is fair to say that all or most of the representatives of the learned societies, and we have consulted many of them, are agreed that the membership of the Science Council should be changed in such a way that it is properly representative of the natural sciences and of the humanities and the social sciences, so that it is half and half.

This body we see as being the major advisory body to the government on science policy. Again if I may say so, Mr. Chairman, I do not think the MacDonald recommendation on the reformation of the Science Council is of any use to the humanists and the social scientists. It would put one or two representatives in the position of appearing to support policies which are primarily developed by the natural sciences and which social scientists and humanists generally may not agree with.

If you have a balance and strong representatives of all groups I think something can be done very efficiently to help the government to formulate basic science policy.

The Chairman: Is this more or less the consensus around this table with regard to the Science Council, that it should be enlarged to have a proper representation also from the social sciences and the humanities?

Senator Yuzyk: The word 'parity' was used by somebody, I think Professor Waite?

Professor Verney: There is a sort of interlocking directorate emerging now, which Senator Carter might like to know about. Professor Dupre, who was on the MacDonald report, is now a member of the National Research Council representing social sciences.

One of the people who worked with this report is now elected to the executive council of the Political Science Association, Mr. Kay. There might be some technical questions, questions of expenditure which he could answer with up to date material from the federal government offices.

The Chairman: I think that if the Science Council is to be limited to a manageable magnitude so far as the number of members are concerned, it may be desirable at some stage to eliminate the representatives of the government on the Science Council.

Professor Verney: It would be of help, Mr. Chairman, if the term science can be made to have a broader connotation than the meaning it has today.

Natural science means social scientists and historians are pressured to behave like natural scientists in order to get funds. The consequence of this is that the students are very distressed, because they feel that research has been geared very often in a particular direction. If the term science could have a broader meaning I think we would all be much happier.

Mr. D. Kay, Member, Executive Council, Canadian Political Science Association: I think a lot of terms are bandied about. They say the 'just society' is very much on our mind. I will deal with your 'pie' comment shortly, Mr. Chairman.

I think basically what is involved here is not only the point of justice but indeed when such a word as 'parity' is brought up, what the social scientists and the humanities people want in this particular country. We have been

lagging so far behind I think it is commendable that every individual organization and association has come forward in the hope of making this particular impact upon the members of the committee.

I would like to draw to your attention, if I can move to the pie itself, how great the difference itself is.

In this survey on federal expenditures the economic community look at the aspects here. Now, in 1966-67, the year in which the expenditures were 79.267 million, the National Research Council, primarily dealing with the natural, physical and life sciences, had a 33.9 expenditure. In terms of the Medical Research Council, health, if you prefer, medical and allied sciences, it was 15.4.

Senator Grosart: Would you define "expenditure?" Are we speaking of total government funding? Are we speaking of total national expenditures on research?

Mr. Kay: It refers to all federal departments, commissions, boards, agencies. All organizations of this nature, including the Crown corporations I should add.

The Chairman: This is the study which has been prepared within the Secretary of State's department.

Senator Grosart: I know the study, but we keep using terms such as "total funding" without defining them and it distorts the record.

Senator Carter: Does it include grants to universities?

Mr. Kay: Yes.

The Chairman: Excluding intramural funding.

Mr. Kay: Excluding intramural and those expenditures which would be defined as inhouse. This gives national health and welfare at 7.0. Now, it is almost appalling, this is not a criticism of the Canada Council, that the fourth one is Canada Council at 5.6. This is basically the body where the humanities and the social science people go for their resources. I think this is basically, if I may use the term, literally appalling in this day and age.

Fortunately, in the 1967-68 fiscal years, and these are estimates which should be pretty close to the final figure, thank God, if I may use the term, Canada Council comes up into

third position with 11.3, but still NRC has jumped to 45.0.

Now, of course, we are into the 1968-69 and 1969-70 years. You can see why with it so far behind there is the necessity for parity and the necessity for justice.

As a matter of fact, this was done in a pie form. I think it is commendable that every possible organization does come and appear in the hope of making some impression.

Senator Grosart: Mr. Chairman, could I comment on this parity argument: It does not make very much sense to me. I understand parity to mean equality. We use the opposite term, disparity.

The Chairman: They were speaking about parity of membership on the Science Council.

Senator Grosart: I know they speak of parity of membership. They used disparity to indicate perhaps that there should be some parity of funding, that is equality of funding.

What the political decision-maker wants to know is what are the ratios of disparity? Merely because there is a group of sciences here called the humanities or the social sciences and another called the natural sciences, it just does not follow that if there are three each one should get a third and if there are eight each one should get an eighth.

I do not understand the parity argument; I do not understand it in terms of the science council.

What is parity? Canada Council funds the performing arts. Are they going to be on it? They would like to be included in the term 'science', if that is the only way to get money, because we have everybody calling themselves scientists today. It is a fact, and, perhaps, an unfortunate semantic fact, that because of the prestige of the word science, mainly in getting money or to some extent in the popular imagination, everybody is saying "We are a science." I am not saying they are not; I am merely saying that this is an unfortunate thing that this often happens to be the only way into the money club.

Professor Waite: The only reason that we are here is because the word 'science' has been so defined that we felt obliged to be here. We felt that we had no option but to make our case. The Special Senate Committee on Science fortunately took a wide range for its focus. If it were not for that we would not even be here.

Senator Grosart: I am all for that. I do not care how you do it. I do not care if everybody calls themselves scientists.

Professor Waite: We would rather not call ourselves scientists.

Senator Grosart: I am glad to hear that. On the point that you have just made I had intended to read one quotation, not to comment on it but to ask the chairman to comment on it.

It is from the Classical Association of Canada's brief, at page 3:

It is of concern to many people that the committee...

I presume that means this committee.

... in enquiring into the research needs of science and social disciplines seems to be overlooking the no less real needs of the humanities...

This is rather hard to understand considering the close interrelationship between many of the so-called humanities and the so-called social sciences. I think the last must be a reference to you, Mr. Chairman.

Mr. Chairman, they find it hard to understand that we have overlooked them; I wondered if you would like to comment?

The Chairman: I do not think that I could be asked to comment here, but the obvious reason that the humanities have not received too much attention up till this stage of the committee is that we have spent most of our time up till now in receiving representations and briefs from the government research agencies. I do not know of any federal department involved in research activities related to humanities. That is the only explanation.

Professor Waite: The Historic Sites and Monuments Board I would have thought.

The Chairman: They did not produce a brief for us.

Senator Grosart: We were going to have them before another committee of which Senator Lamontagne is chairman. The Historical Sites and Monuments Board will be appearing next week before that particular committee.

Senator Yuzyk: We still did not get a reply as to the re-structuring.

The Chairman: I think we have got at least the beginning of a reply.

Senator Yuzyk: As to the representation on the Science Council itself.

The Chairman: I thought that we had some kind of unanimity here.

Professor Waines: I thought we had too, Mr. Chairman. I thought that we had the idea that there would be about an equal number of social scientists and humanists on the one side and natural and health scientists on the other. This does not imply that we are arguing that there must be parity with respect to the amounts of money.

This is something that will have to be determined at some time by the appropriate government body on the advice of the Science Council.

Senator Yuzyk: That statement makes it quite clear.

Dr. Wiles: I am prepared to support that, Mr. Chairman. My objection, frankly, is based upon the notion that the term 'science' will continue to be misleading. In its historical sense it embraces all of the disciplines in learning. There is no question about the origin of the word but in its current use it seems to have been used exclusively, and I think may continue to be used exclusively as a reference to the natural experimental sciences.

The social sciences have to use the adjective, social science. I am not suggesting for a moment that their material and their investigative procedures are in any way inferior. The humanities do not ever call themselves scientists, though we have a flair for accuracy and insist on the relevance of evidence.

Senator Yuzyk: You do use scientific methods.

Dr. Wiles: No, sir. We are making use of computers now, but the interpretation of an ancient piece of literature requires some precision, it is true. One of the practices of the experimental sciences I suppose is to remove the thing investigated from its immediate context. This is not invariable, but that is quite impossible in appraising the work or investigating the creative effort and the impact on the imagination of a fine poem or a great novel.

It seems to me, if I may be so bold, Mr. Chairman, that even the designation of this committee seemed at first to imply concern exclusively for the experimental sciences. As I said in the brief and in my own remarks, it

is infinitely gratifying to know within the humanities that this committee is concerned with the whole range of disciplines. It seems to me though that there ought to be a better name than Science Council. Research Council perhaps already has acquired associations that are inappropriate, but it would seem to me not at all to exclude the humanities and the social sciences.

In such a council, whatever it is called, the thing we have been calling 'parity' is interpreted to mean equal representation from this full range of disciplines, including humanities, social sciences, natural sciences and now medical sciences. Where the practising performing arts are to come into this I do not know. It would seem to members of the Humanities Research Council that grants to promote and to encourage the performing arts are not at all in the category of grants to support research.

Whether the performing arts to be in any sense a concern of this science, with quotation marks, council or not, I do not know but it is not a matter of our direct concern this afternoon. Parity as I see it, sir, surely implies equal representation from the humanities and social scientists on one side and the sciences on the other side.

Senator Grosart: Why equal? What is the scientific basis for saying it should be equal?

Dr. Wiles: It seems to me, Mr. Chairman, that one could have insisted that there be greater representation from the hitherto neglected humanities and social sciences. We are not pressing for that. Equality I should say is a significant element in the culture of this nation.

Senator Grosart: Yes, significant, but why equal. I am not objecting to the fact that there should be much greater representation. I would like to see some basis for equality, for exactly the same number from each side.

Professor H. G. Thorburn, Past President, Social Science Research Council of Canada: The rationale here I think is not that the social sciences and the humanities are looking for equal amounts of money. They might like it, but that is not a rational basis. We see the Science Council as a body to which the government will turn for advice on the federal support of research and, indeed, in the realm of the federal government for education as far as the federal government's mandate runs. Therefore this involves all of these four fields.

Now, if this debate, which it is bound to be, between the representatives of these four areas is to be carried out on the basis of equality, at such a point some kind of a conclusion based on the merits of the case is to take place. There has to be roughly equality between the participants so that one group with the heavy fire power will not be able to destroy the other.

The conclusion therefore is to constitute the Science Council roughly on a basis of equality which should produce the satisfactory answer which is justifiable in rational terms. It will probably come out with a recommendation that certain areas require more support financially at this time than others. If you load the dice in the first place by saying that the council upon which you call for advice should have more of one group than another, you are not laying the basis for the kind of balanced consideration of the matter that we should have if the most considered and fair amount of advice is to come forward to the government.

Senator Grosart: The assumption is that everybody would vote the party line.

Professor Wells: I should explain that I am here as a member of the Council of the Classical Association because our president was unable to come over from Vancouver. My first acquaintance with the Humanities Research Council brief was this weekend when it was suggested that I might read it in preparation.

At the risk of disturbing this apparent unanimity, I do wonder why everyone is now coming over to the idea of saying that the best means of getting advice to the government on the humanities and social sciences is through a reconstituted science council.

The arguments which the Humanities Research Council brief brings forward in its last three paragraphs seem to me to be quite strong ones. In particular I refer to the comment that the Science Council, with its Secretariat and its membership already deeply involved with the natural sciences, the addition of a humanities division could, in our opinion, not be successful.

To this I would add that, as Senator Lamontagne has pointed out, there is no government agency, with possibly one small exception, directly concerned in itself with the humanities.

There are several directly concerned with the natural sciences and the medical sciences.

The Chairman: And the social sciences.

Professor Wells: It seems to me inevitable that the government should have, as a government taking political decisions, a greater commitment to the natural sciences and medical sciences. They need more money. Even as a classicist I have to argue that they are probably of more direct and economic value to the country than the study of Roman pots.

I do wonder why we seem to have abandoned the idea of two separate, but, to come back to the word equal, bodies, a Science Council and a Humanities Research Council plus social research council, each of them speaking in its own name and leaving it to the government or to committees like this one to adjudicate between the two, this being surely essentially the function of government.

Professor Thorburn: I think the alternative that is posed here by these two suggestions relates to where the debate will take place. If you have two councils, each making recommendations separately to government, then government itself must adjudicate between these without seeing the argument of each and countering one another.

If you have one council, then the exchange will be between the representatives of all of the disciplines. I would think this would make for a more rational basis for discussion, because you would have all of these points of view more or less thrown into the one pot. The result would be I think that some kind of formulated policy or at least tentative suggestions would come forward and would be available for assessment. They would not receive separate recommendations from each, both asking for more money. It is hard to know just how to weight the one against the other.

It seems to me that these people should be brought together to assess their own priorities in the face each of their own problems. If you cannot bring these people into one room it seems to me that you will not have as sound a base for policy making.

The Chairman: Is there not also the argument that, apart from the competing relationships existing between disciplines, there should be also more and more a complementary relationship as we move towards these larger so-called mission-oriented programs where an inter-disciplinary approach or a multi-disciplinary approach will be required?

Professor Rogers: Mr. Chairman, I want first of all to reinforce what Professor Waite said about the use of the term 'science' and the way in which it has been used globally to incorporate the social sciences and the humanities.

This first came up I believe in connection with the MacDonald study group when it became quite apparent that they looked upon their terms of reference in a very broad way. It was as a result of debates with the two research councils and the Canada Council that Canada Council ultimately co-sponsored that study group.

I would also like to mention in connection with what Professor Wells has said, that the brief of the Humanities Research Council was prepared many months ago and quite a lot has happened since then.

One of the things that has happened, of course, has been the recent publication of the report of the MacDonald study group. I think part of our change in thinking stems from the fact that we disagree with some of the findings of that study, particularly in so far as the Canada Council is concerned.

I do not think the two things are necessarily mutually exclusive. I think that if we ask for some degree of parity—I suppose one can only ask for parity and not some degree of it—on the Science Council it does not mean that we do not see a genuine role for the two research councils and independent private bodies representing the grass roots of the learned societies.

Finally, in connection with what Senator Yuzyk was saying...

The Chairman: He is a professor, too.

Senator Yuzyk: And an historian.

Professor Rogers: It seems to me that his mention of what I consider to be a fact, and a sad fact, namely that particularly we humanists have not been articulate about our views, is precisely the point in asking for a voice and a serious voice on the Science Council.

It seems to me that if the humanities and the social sciences, natural sciences and medical sciences were represented in some arrangement of parity this would make excellent sense.

Dr. Verney: Mr. Chairman, have I your permission to pose to you a question of the sort you have asked us?

Senator Haig: He may not answer it, but you can ask it.

Dr. Verney: In the sense that you have treated us as devoted academics, whereas you are representing the federal parliament. You know what is wanted; are you sure that we have any understanding of the problem? If I can twist it round a bit, there is a growing feeling in the provinces and I have mentioned that word for the first time today, that education involves research. We have not mentioned that many of the learned societies now have a separate organization in Quebec and that some of the universities in Quebec are concerned about the provincial role.

I know that in Ontario and, after all, three quarters of my association and the work that is done is in Ontario, people are beginning to think they might also consider education to involve research. The MacDonald committee assumed that education, university building is for the provinces and research is for the federal government.

Might I suggest to you that unless you act speedily, unless you are united and decide whether you want a Canada Council or something else, you may well find that the provinces, particularly Quebec and Ontario, will move into this field. I think that would be a very serious matter for the federal relationship, because scholars at the moment, as you can see, have been federally oriented.

Increasingly we find that the provincial government is trying to do things and demanding things, not only in research. So far Canada Council and the National Research Council have kept us federally organized.

So I would like you to think not only of us as perhaps divided; because you can see we are coming together, but I would like you also not to be divided amongst yourselves as to what you intend to do and to act speedily.

The Chairman: Of course, we have not reached the point where we will know whether we are divided or not, because we have not discussed yet in the committee the kind of recommendations that we are going to make.

This kind of reflection that you are inviting us to make will start, I hope, early in July.

Senator Grosart: Mr. Chairman, there is a good comment on this point in the brief of the Political Science Association at page 3, paragraph 2.4, which reads:

There are a great many areas of government and politics in this country about which we know very little, and often next to nothing.

The Chairman: If we continue to have books written by former ministers we might learn more.

Senator Carter: Speaking of the statement that we have heard a number of times about the social sciences and the humanities coming together in their research councils, I was wondering why it was that so many paragraphs in the Humanities brief were almost identical to the paragraphs in the Social Sciences brief?

The Chairman: It was probably the same author.

Senator Carter: Maybe they had the same sources, but are you thinking of coming together to the point where you will agree on a whole broad spectrum of needs and out of that broad spectrum select your priorities, so that you speak to the government or to the Science Council or whoever you are going to deal with with one voice? Are you going to establish a consensus among yourselves, or will you be competing, each one pressing for his own share of the pie?

Professor Waite: I suppose the best answer to that, Senator Carter, would be the principle that was stated this morning, that there is a certain principle of federalization here. The Social Sciences Council and the Humanities Research Council do speak on certain collective matters but, obviously, each one of the separate associations belonging to them may have very much its own views at some particular point. This is nothing strange in Canada; there are analogies all over the place. We cannot pretend, obviously, to speak completely for the learned societies in the areas of the humanities or the social sciences. We have collective policies; there are obviously divisions within them where you get certain differences. The Economic Association and the Social Research Council have certain views that they want made known. This is perfectly understandable; I do not see how one can really expect anything else.

There is certain common ground and that is obviously reflected in the briefs you have seen today.

Senator Carter: What I am not quite clear on here is that from what I have heard it seems that everybody is satisfied that they are getting a fair share the humanities are getting a fair share of the Canada Council pie; there are no complaints about that?

Dr. Wiles: Not for libraries.

Senator Carter: No, apart from libraries; the people represented here today are not representing libraries specifically. I gathered from what statements have been made that everybody was pretty well satisfied that as far as Canada Council goes they were getting pretty fair treatment.

Who do you blame for the fact that you are still not getting what you think you are entitled to as compared to the natural sciences?

Professor Waite: I am not going to speak any more; I will just make this one point. We do have a feeling that the humanities are under-supported vis-à-vis the social sciences. If you take, for example, history out of the humanities then the disparity between the remainder of the humanities vis-à-vis the social sciences becomes really very striking, of the order of approximately one to three.

Professor Rogers: I have one further comment on that precise point, Mr. Chairman. I think what Professor Waite has said about the common voice of the social sciences and the humanities is quite right. On basic policy it is very likely to be a common voice. The research needs are very similar, but on specific points the needs may be very different according to the disciplines.

I think when it comes to assessing what comes from Canada Council to the two respective disciplines, one point that must be remembered is that the social scientist has, on the whole, many more sources of research funding than the humanist. The humanist relies very thoroughly on the Canada Council, whereas there are many government agencies that require research facilities from the social sciences.

Professor Verney: I merely have a comment, Mr. Chairman: Could we get more with a separate organization is the question we have put to the Canada Council. They have argued that they have done extremely well and if we separated we would get less. That is why when you ask us would you not wish to be separated from the Canada Council we are not sure what would happen to us.

We might, through the beneficence of the government, get a lot more; on the other hand, we might get less. We just do not know what the answer to that question will be.

The Chairman: Is your only source of information or worry at the moment the Canada Council?

Professor Verney: We thought it proper to ask the Canada Council just this question and this was the reply they gave us. My only concern was when I asked this question, what about the six million for research institutes? They said there you must go directly to the government. So that suggested to me that there was a limit to what the Canada Council could do for us.

Senator Yuzyk: I would like to ask the teachers of English/whether they are getting anything from Canada Council at all?

Professor Chorny: Senator Carter's question was about satisfaction; there seems to be another kind of area involved here at this time and I did not want to intrude at this point. The fact is that to the best of my information Canada Council, because of its terms of reference which precluded giving grants for pedagogic purposes, does not support research related to the teaching of English.

To illustrate, if I wish to pursue research in the areas of pure language in the sense of the philosophies and psychologies of languages and the developments there, it is possible that I might get a Canada Council grant. If I wished to pursue it and to try to discover what applications may be made in the light of new discoveries—and this is where we desperately need help—unless I lie, which I am not prepared to do, and falsify my reasons in some measure, I cannot get it.

As far as travel is concerned, if you will bear with me I would like to comment on a footnote in our brief: In 1967 I was asked by the National Council of Teachers of English to chair an international conference on the teaching of English which involved teachers in college.

There were sessions in linguistics, in language, in literature of the world. I was asked by two members of the university English department who had applied to Canada Council for grants in aid of travel whether I could intercede. The then president of the Council also attempted to intercede. The answer was: No, travel grants are not available. Yet here we were able to draw distinguished scholars from the United States and England and the support was not forthcoming in Canada. This is the kind of problem that we face.

The Chairman: Has this been your experience, Professor Wiles?

Dr. Wiles: Mr. Chairman, I think it is true that there are areas of activity for which grants have not been recommended for research and that they do include pedagogy, if you like.

I see this as a fact. I personally regret it. There are other areas of learning, of investigation, of cultural activities which are also excluded so far as research is concerned. Investigations in the history of music are acceptable, but the question of improving the techniques of performance is excluded.

I am very happy, Mr. Chairman that this aspect of Canada's total effort in cultural matters has been brought before this committee. It is not by terms of reference of direct and immediate concern to the Humanities Research Council. I think it is regrettable that it should be so.

As for the acute end of it, it is quite clear that by definition we are an association of Canadian university teachers of English and questions of pedagogical procedure may very well be discussed at our annual meetings, but this is under the guise, as it were, of a professional concern for the discipline rather than pedagogy.

You are asking whether it has come within my experience. I do know of this and I can support Dr. Chorny in his statement and his complaint that this sort of request has been turned down. I think it is regrettable.

Professor Chorny: My point again whether such support should be made from Canada Council is another matter.

In part our brief is a request to you gentlemen to consider the merits of the situation and to see whether some kind of assistance of enabling measures may be provided. I believe it was Professor Verney who earlier made the comment that leadership must stem from the grass roots.

Again, I can offer you no scientific evidence but I can give you an opinion that is shared by many of my colleagues, that there is emerging in the profession of teaching English in the schools of Canada a movement which I think can have an important impact on education.

The people involved are not looking for what is sometimes called a hand out. All they are looking for is some means which will facilitate their action.

The Chairman: When you speak about schools, do you mean secondary schools and primary schools?

Professor Chorny: Elementary and second-ary schools.

The Chairman: As you know, the Canada Council has limited its assistance up to now to the level of universities.

Professor Chorny: I am quite aware of that, yet my point and here we seek your guidance and your assistance is, is there any way to facilitate the kinds of action we have proposed, whether through Canada Council or any other measure?

Senator Carter: You have all recommended in your briefs that there should be institutes and seminars. Is that within federal jurisdiction or is it under the provinces?

Professor Chorny: With due respect I can only cite an experience from the United States, where under the National Defence Education Act the federal government did provide funds for such institutes, even though education is essentially a state right.

These institutes were under the jurisdiction of universities and were planned for university.

Senator Carter: Yes, but teacher training is a provincial responsibility and one they guard very closely. They licence their teachers and each province has its own normal training schools for teachers. When you get into the matter of teacher training you seem to be treading on thin ice.

Professor Chorny: Let us use Alberta as an illustration. Yes, Alberta is responsible for the preparation of its own teachers. This responsibility is vested in the universities but why may not these same universities lay on in-service courses for teachers? They would have complete control of the courses.

Funding, or at least some assistance for holding these special in-service courses would be provided by the federal Government. Would this be, I ask you, so much different from the assistance they give to other institutes?

Senator Carter: I think the problem would be in convincing the federal government, when there are so many other needs competing for it, whether they should stick their necks out into this particular field.

Professor Chorny: I have to come back to a comment which you made earlier when it seemed to you that there was not liaison among the bodies and we found that there

was. This is in part the situation, that there is no effective liaison between the provinces at least as far as those ground roots things, the teaching of English, are concerned. The Canadian Council of Teachers of English is one agency which is attempting to cope with this. At this time the problem exists, so you have potential on the one side; you have promise on one side, but you have not the means, because you have not got the kind of liaison which you were interested in.

My question again now is, how do we go about it?

The Chairman: There is an inter-provincial council or committee of provincial ministers of education. Have you tried to make representations before them?

Professor Chorny: No, we have not, not to this point, again for reasons that our organization is young and the fact that this organization assumed a more formal role only last year.

The Chairman: That might be worth while to investigate.

Professor Chorny: The precedent again in other nations is there. The model is there, is the situation worth more exploration?

Senator Carter: Could the federal effort not be directed towards the efforts being put out now by this Council in some of the provinces, this joint Council, to revise educational standards? A teacher can teach in one province and he moves tomorrow and is not permitted to teach. We can have standardized training programs and standardized diplomas for teaching. I would like to see standardized examinations if you are going to have them.

A child today moving from one province to another should not be handicapped because each province has got a different system. This I think is a legitimate responsibility for the federal government to tie in, develop and direct the forces already at work into developing a more uniform system for the whole country.

Professor Chorny: My acceptance of your point would depend on what you mean by standardized, sir. If you mean that preparation of all teachers and of all students in this country would be identical, then I would have to argue against it. I would support you wholeheartedly if you mean that we should improve teacher preparation to some kind of

equitable standard throughout the provinces. This we need and this is implied in our brief.

The Chairman: It is almost 5.30 and we have to be back, as you know, at 8 o'clock in the Senate chamber, so I suppose that we should bring this meeting, unfortunately, to a close very soon. Are there any other questions?

Senator Yuzyk: I have a very general question. This is about the possibility of the establishment of a ministry of science, or a minister in charge of science in the federal government.

I would like to hear some of the views, just very briefly, as to whether such a ministry would make it much easier for you to make your reports and to present your points of view more effectively?

The Chairman: I think we should start with the political scientist on this one.

Professor Verney: I should certainly like to enter into discussions about this and see the implications. It would seem on the face of it that some closer connection with the government is very desirable with the immense development that is about to overtake us. I think this morning we entered into very important questions of the intervention of government. I think we all accepted that government should not be intervening in research. I think by this afternoon we realized that a greater effort is required and some form of organization, such as a minister, might well be considered.

I would favour not the setting up of a minister at this time without enough thought, but the continuation of this inquiry. That is speaking for myself.

The Chairman: Are there any other comments?

Professor Mayo: That is not something that we pursued enough to come here with firm opinions on.

Dr. Wiles: Mr. Chairman, it is surely more expedient that we should focus attention upon the body which will gather information and appraise relative needs of this community and therefore and on that basis be able to give advice to such persons, ministry or body as will persuade government to allocate adequate funds.

Whether this is best done at the point of action by the naming of a minister I am

afraid I cannot say. I agree that it is a matter that might well be explored.

I am not sufficiently acquainted with the difference between an elected minister and the deputies who continue to gather information, file it and presumably give advice. I see complications here.

Senator Yuzyk: This minister, of course, would be co-ordinating science policy throughout all the departments of government; that is why I asked this question.

Dr. Wiles: This would mean, Mr. Chairman, that he would be responsible not merely for the direct immediate and important concerns of the bodies represented here, but for numerous government agencies which themselves have very important requirements which need to be presented.

I see that this would be taking into that arena matters which in my view at the moment should better be discussed and appraised by an advisory body such as the—I will have to put quotation marks around the words—Science Council.

The Chairman: Unfortunately when the Science Council has concluded its studies and is prepared to report, it has nobody to report to at the moment in fact. In theory, of course, there is always a minister responsible for something, but when the minister is so busy doing something else, including the Prime Minister, then the Science Council may feel more or less like an orphan.

Professor Verney: Should we, Mr. Chairman, set up an institute of comparative studies to see how this has worked out in other countries, because other countries do have this organization?

The Chairman: Yes; most countries on the continent of Europe have such a minister. I suppose if you have any additional comments to present to us on this problem you will have to do it fairly soon, because we still intend, it is probably naive on our part, but we still intend to present the report by October.

Senator Yuzyk: Mr. Chairman, could I ask Dr. Waines to make a comment?

Professor Waines: I could only make a personal comment on that matter, Mr. Chairman, for what it is worth to you. I agree with some of the others who have spoken, that this needs much deeper study. I think you yourself, Mr. Chairman, put your finger on the

real problem: To whom does the advisory body report and recommend? This suggests to me, again off the top of my head and in my own personal view, that there should be someone, a minister I would think and I would hope, a very strong minister, in the cabinet who would be responsible for the whole range of, I do not like calling it science policy because, again, the concept is too narrow, but all these things are inter-related at the policy level.

There should be some single point I think where the total implications and consequences of policy are assessed because the decisions, as Senator Grosart said a number of times, in the end are political decisions.

Professor Waite: I might suggest a minister, or ministry of research as a word that would get us out from under this awkward problem which in fact accounts for the brevity of the brief of the CHA, and, I am sure, must account for the brevity of the briefs from some of my colleagues.

I put this brief together by myself because there was not time to consult anyone, in a matter of five days. This is because the word science led me think there was no reason to come before this committee. It was only on Senator Lamontagne's express invitation that we are here at all.

I am particularly grateful to you and I would like to suggest the possibility of—obviously I cannot change the Senate Committee's name—I would like to introduce this idea that research would assume underneath it all these problems we have discussed today.

The Chairman: I think when you look at our terms of reference, although the title of our committee is very short our terms of reference are fairly broad and fairly detailed. They spell out more or less what kinds of disciplines we are interested in.

Thank you, gentlemen, for your views. I hope that we will not disappoint you.

The committee adjourned.

APPENDIX 123

Brief prepared
for
The Senate Committee on Science Policy

Presented
by
The Canadian Political Science Association
100 St. George Street, Toronto, Ontario

June 10, 1969

MAIN POINTS

1. Political science in Canada is a relatively under-developed field of study and will require very great infusions of financial resources to overcome this deficiency.
2. While it is desirable for financial support for political science research in Canada to come from several sources, the C.P.S.A. is content for the time being that the Canada Council remain the "chief granting and disbursing agency" of the federal government so far as this discipline is concerned.

Introductory

For many years the Canadian Political Science Association was an organization which included all branches of the social sciences, and its Journal did likewise. A few years ago the sociologists and anthropologists "broke away", and set up their own Association and Journal. In 1967, the C.P.S.A. divided into two -- the C.E.A. for economics, and the C.P.S.A. for political science, each Association with its own more specialized Journal, the first issues of which appeared in March 1968.

The C.P.S.A. has, since then, been largely preoccupied with the problems of re-organization: We have not as yet undertaken any full-scale study of the extent and nature of political science research being carried on in Canada, or of the present and future research needs. The intention of the Association however, is to make a survey of the discipline as a whole, and of its research and other needs in the near future. It is hoped to proceed with this extensive project next year.¹

1. An Under-developed Subject

- 1.1 The first important point to be made about political science in Canada is that it is on the whole a very under-developed field of study. The reasons for this have not been investigated but it seems probable that they are similar to the reasons for the underdevelopment of the social sciences in general in this country.

¹Some surveys of the social sciences in Canada have, of course, been made --the latest being that of Professor M. Timlin. Of those concerned only with political science, perhaps the 3 best known are: "Political Science in Canada" by Kierstead and Watkins, in Contemporary Political Science, UNESCO, 1950; MacGregor Dawson's Report to the Social Science Research Council, 1960; and G.B. MacPherson's "Canadian Political Science" in The University Teaching of Social Sciences: Political Science, UNESCO, 1954.

1.2 In the case of political science there is a particular reason: the subject is a very recent arrival on the University scene, at least in any substantial way. The teaching of political science in the universities of Canada arose for the most part within Departments of Economics, or as they were formerly called, Departments of Political Economy. Since the second World War these disciplines have become separated into different departments, until only one or two universities still retain the old nomenclature and keep economics and political science within the same departmental structure. (In the United States, by contrast, political science arose, generally speaking, in conjunction with departments of history.)¹

1.3 As separate departments of political science became established, the subject has surged ahead, although even yet Canada is a long way from providing enough graduate students to staff our university departments. Consequently, university recruiting has had to be undertaken abroad, most notably in the United States and the United Kingdom and to a lesser extent in France and other countries. But as the graduate programmes of studies in political science are expanding rapidly, the trend may change in the near future.

2. Political Science Research: Under-developed

2.1 With regard to research, one point stands out above all others, namely the vast amount of research that needs to be done on government and politics in Canada and the relatively small amounts of money that are available to finance such research. This point has been noted by the Bladen Report and the Macdonald Report, and can be emphasized yet again in several ways.

¹If we take the population of Canada as roughly 10% of that of the USA, we might expect perhaps that Canada would have roughly 10% as many professional political scientists as the USA. In fact, it is doubtful whether Canada has 4% as many.

- 2.2 In the past, university professors of political science have been so busy with teaching -- to meet the rising student demand -- that they have not had the time to explore much of the unknown territory in political science. In order to do research, professors require spare time, which has been (until recently) a very scarce commodity. With the lightening of teaching loads in recent years, much more research has in fact been done. But a great deal of money is still required: for summer grants and stipends; and to relieve professors of some of their duties during the year; and for money for leaves of absence, travel, research assistance, and the like.
- 2.3 In the second place: the nature of much research has altered in the last decade or two. The result has been an enormous rise in the cost of many types of research. The reference here is to research that requires elaborate model building, travel and field work, extensive surveys and team work, data banks and computer time, and retrieving and analysing the ever-accumulating official records. These are very expensive types of research and point to the fact that larger and larger amounts of money will be required. We do not simply refer to the sole cost of research but also to the extra overhead costs which the universities are forced to undertake. Accordingly, the C.P.S.A. suggests that granting bodies award additional sums to cover administrative and other overhead costs of research grants. (In mentioning this, we do not, of course, ignore the often grossly inadequate research libraries of Canada.)
- 2.4 There are a great many areas of government and politics in this country about which we know very little, and often next to nothing. This applies at the national and local levels of government, and even more conspicuously perhaps at the

provincial level which has been a notoriously neglected field. It applies also to fields of study, as well as to levels of government: to political parties and interest groups, to Cabinets and offices, to public administration, to political sociology and the civic culture, to "private" politics, to urbanization, to public policies, and dozens of other unexplored fields.

- 2.5 Some of this research would have a quick "pay-off" in its contribution to public policy-making, a fact which is becoming more apparent with the growth of "contract" research by governments.
- 2.6 We do not want to leave the impression that political science should be entirely concerned with "applied" research, or with the Canadian scene or the operation of the Canadian political system. There are also, as in all scientific research, tremendous openings for basic theoretical investigation. These too, are areas into which as yet only a few scholars have made a few occasional forays, and which require much more money and more personnel. Such research also requires more government and public forbearance, because it usually has no short-run "pay-off".
- 2.7 The above points have merely emphasized the desperate need for research in this country and the consequent need for more money, in amounts as yet undreamed of.

3. Existing Research Support

- 3.1 It is only appropriate that we should pay tribute to the considerable progress in research that has been made, particularly since the second World War. This has come about in several ways. 1) For one thing, as university teaching loads

have become somewhat lighter, more and more men have turned to research. 2) Then again, with the setting up of the Canada Council, a great deal of research has been made possible through its granting and Fellowship system. 3) Further, one should not underrate the amounts of research (mostly perhaps in applied fields) which have been commissioned by various departments of government, and above all by Royal Commissions of various sorts both federal and provincial. 4) Nor do we forget the long-standing efforts of the Social Science Research Council, which pioneered aid from United States Foundations before the Canada Council was established.

3.2 The above are, in toto, the main sources of research support hitherto existing in Canada. To them, we can now add the small trickle of money which universities are setting aside for research in political science.

3.3. The social sciences, political science among them, are in a peculiar position. They have their links with the humanities on the one side and with the natural sciences on the other. There are many signs that we are in a period of transition, and that the social sciences are moving more and more to a unique position for themselves. This seems to be borne out by such things as the establishment of faculties of social sciences at our universities, and by the establishment of social science research foundations and the like by foreign governments.

4. The Structure of Support

4.1 In the meantime, however, it seems to us that it might be premature for the social sciences to sever their historic connection with the humanities, more especially with certain branches of history, philosophy, law, and the like. There

is room for this connection, as well as for more emphasis upon survey research and statistical and computer methods, and for a growing alliance with some branches of natural science.

4.2 For that reason, the C.P.S.A. takes the stand that, at least in the near future, we are content to see the Canada Council act as the chief granting and dispersing body for political science. We disagree with the view expressed in the Macdonald report that the responsibility for granting in the social sciences be taken away from the Canada Council and be given to a new social sciences and humanities research council. We would not endorse a sharp separation at this time between the humanities and the social sciences nor between the humanities and the arts.

4.3 Then too, we believe that much political science research, often specialized, will inevitably continue to be done and commissioned by government departments, Royal Commissions, etc. We think that this is a good thing, and that it would be unwise to consolidate all support for research into one federal granting agency. It seems to us of great importance that a diversity of granting agencies should exist with different criteria of support, so that a rapidly developing discipline may proceed on all possible fronts, and often in inter-disciplinary fields.

4.4 Diversity of support is of unique importance to political science research, the findings of which will often be embarrassing to governments. The political scientist who is faithful to his commitment to truth, will often find himself telling the society things it does not want to hear. The independence to pursue and publish such truth must be safeguarded carefully as in all science. We do not want

research prostituted in this country, or any such scandals as arose over the C.I.A. relation to the Universities in the United States. (There is another problem here: that of the nature of the contract with a political scientist signs when he undertakes research for government or any of its agencies. The problem arises chiefly over rights of publication.)

4.5 For similar reasons, we should be sorry to see support for research come only from the federal government, and so we endorse the support of research by other governments, and also (we strongly emphasize this) by private foundations whether directly or through subsidiary agencies such as the Social Science Research Council or the Canadian Council on Urban and Regional Research. In brief, it seems to us short-sighted and unwise, that on grounds of "efficiency", there should be any rigid centralizing of the grant structure by which federal money finds its way to political science research. We oppose the principle of a single agency or channel, and instead endorse a variety of methods, and "buffers" between government and universities, and above everything else, we endorse more funds.

4.6 We believe that this Senate inquiry can result in nothing but good, and we are very happy to take part in it. We hope your study will generate more interest in, and support for, greatly increased political science research. Such research, beside its obvious usefulness for government policy-making in a complex and ill-understood society, is also a necessity if Canada is to be noted for its civilization as well as its influence. Such research is also vital if we are to retain in this country the research-oriented political scientists, now rapidly increasing in numbers.

APPENDIX 124

The Canadian Historical Association
Brief to
Senate Special Committee on Science Policy
February 28, 1969

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1. Briefs can be brief. In this one, brevity is unavoidable, since the range of the Senate Committee's work on Science Policy has only recently come to the attention of the Canadian Historical Association. Nevertheless, it is desirable, even at the risk of not being fully comprehensive, to submit relevant points for the Committee's consideration.
2. History is sometimes conceived as a social science, sometimes as one of the humanities: it is really of both. History deals with the past, in the full range of man and man's activities. Nothing human is really alien to it. Thus history describes man the individual and man in society. Inevitably it uses all the social sciences, economics, political science, psychology, sociology; some of the natural sciences, geography, geology; even medicine. History is also, perhaps fundamentally, philosophical: certainly it uses philosophy and literature. History is, in short, a big subject.
3. The Canadian Historical Association is an organization of 1500 historians, archivists, both amateur and professional, mainly resident in Canada. Their fields of interests include all history, not just Canadian.
4. Many of the active members of the Canadian Historical Association are University professors. It is commonly held that teaching and research go hand in hand. This is broadly true for teaching at advanced levels (though not always so even then); but for young undergraduates an historian deep in his own research and writing may very well be a dead loss as a teacher. It would often be better for the young and impressionable university

student if the historian were reading for his lectures instead of researching for, or writing, a new book. Some academics do both well; but some of the greatest teachers of history (as well as some of the worst) have been uninterested in research and writing.

5. This question of the actual teaching of history, vital though it is, cannot be dealt with in this brief. This submission will be concerned with what can be called the scientific activities of history, that is, research.
6. History is made by men, but it is written from records. Thus the acquisition, the preservation, and the access to records is a fundamental need if History is to flourish. This means, first of all, Archives, and the Government's support of them. Canadian historians have particular reason to be grateful for the work and the traditions of the Public Archives of Canada; in no other Archives in the world, that we know of, is it possible to work 24 hours a day 365 days a year. This is a superb arrangement. In one summer, on a Canada Council grant, a scholar from, say, British Columbia, can put in a monumental amount of work at the Public Archives of Canada or the National Library. (Provincial Archives, incidentally, are not nearly so accessible.) Good as the Archives of Canada are, it is becoming clear that social history, now coming into its own, will impose a much wider range of demands upon Archives. This means, in effect, the acquisition of business records, and institutional records of great variety; it also means access to, and facilities for, non-written records, films, radio broadcasts, TV programmes, and tapes from the interviews of oral history programmes.
7. For the mature and established scholar most Canadian universities have systems of sabbatical leave, one full year on half-pay at the end of six, or sometimes seven,

years of service. Canada Council has Senior Fellowships which, with half-pay from the Universities, make it possible for a scholar to spend a year at research or writing. For many of us this is a hallowed time; time to work unimpeded, to get thoroughly into one's writing, to stretch one's mind, and even perhaps to live in a new environment.

8. Younger scholars, especially those with families, need support to get to Archives, especially for transportation to and from Ottawa, or wherever Archives are, and some support while there. For this purpose Canada Council has been, and is, quite indispensable. As the profession grows, and as Canadian history in particular continues to ramify at its present remarkable rate, this kind of support will have to be extended. Historians need access to Archives outside of Canada, especially those historians who are working in European, American, Asian, African or Commonwealth history; here again Canada Council support is vital. Canada is now too big a country to simply expand its own historical backyard. Canada's role in the Commonwealth, in the United Nations, and in world affairs in general, demands continued and increased support for historical research outside of Canada, in fields that do not necessarily relate directly to Canadian history. We have now a small nucleus of experts in Africa, the West Indies, and India: we can build substantially upon this.

9. Support of publication is an important part of History in Canada, both for periodicals and books. Canada Council makes grants to support learned journals. So do other bodies. The Canadian Historical Review is, for example, partly supported by the University of Toronto Press, since subscriptions do not cover costs. Many other journals, valuable for History, are subsidized,

sometimes heavily, by universities: the Canadian Journal of History (University of Saskatchewan); Journal of Canadian Studies (Trent University); Social History (Université d'Ottawa and Carleton University); and more general ones, like Queens Quarterly or Dalhousie Review. Revue d'Histoire de l'Amérique Française is subsidized mainly in Québec but its subscribers range nationally. Support for the publication of academic books--academic, it is hoped, in the best sense--is organized through the two research councils, the Humanities Research Council and the Social Science Research Council, which administer Canada Council funds. Many of the best historical works recently published in Canada have had subsidies from this source. It is conspicuous that during the depression years, for example, many of the best historical works published in Canada were subsidized: the Canadian-American Relations series, supported by the Carnegie Endowment for International Peace, or the studies that came out of the work of the Rowell-Sirois Commission. In a sense all books that come from the University communities in Canada are subsidized, that is, by the universities themselves, with their modest grants in aid of research or publication.

10. Especially noteworthy in recent years have been the efforts of Government departments to publish good history. The Department of National Defence has done conspicuously good work in the history of the Canadian Army and the Canadian Navy; more recently the Department of External Affairs has published an excellent first volume in what it is hoped will be a continuous series of documents from departmental files. Parliament itself has published, through the Library of Parliament, its own debates for 1867-1868, as a start toward filling the gap before Hansard appeared in 1875. Administrative histories of

the departments would be a useful next step. Some of the work of the early Deputy-Ministers of Canada is almost unknown; and some of them were exceptionally able and dedicated men.

11. It is hoped that the Canadian Broadcasting Corporation will arrange a comprehensive conservation programme for its archives of radio and TV programmes. In fifty years some of these will be indispensable for the history of our own times.
12. The Canadian Historical Association would like to support the continued growth of the work of the Historic Sites and Monuments Board. This body has now acquired a small staff of considerable talent and expertise; it has traditionally had the task of marking historic sites; but its more important task for the future is in preserving, and restoring, significant and attractive historic buildings of Canada. Our visible history melts away around us; buildings are demolished faster than we can catch up with them even to find out if they are worth preserving. On the other hand, buildings are being saved, by the efforts both of Historic Sites and of individual provinces; and what we do have left we ought to preserve whenever condition, site, and significance make it possible to do so.
13. The mission of History in Canada, more especially of Canadian History, is to dispel myth. Unscientific history makes myths: accurate and honest history should dispel them. There is no need to point out the relevance of this to the History of Canada, which, at the level of high-school texts, has been shot through with misconceptions. It is perhaps inevitable that high-school books should be out of date with current research: but the gap in Canada, at least until very recently, has been alarming. * The hope for Canadian history are the

*See for example the recent study by the Ontario Institute for Studies in Education, What Culture, what heritage?

tough-minded and thoroughly professional historians who want to cut through myths and conventional interpretations and get at the truth. One example of this recently is the book of Fernand Ouellet, Histoire économique et social de Québec, 1760-1850: structures et conjonctures.

14. Attempts to do this by the Canadian Historical Association itself is appended to this brief. These Canadian Historical Association booklets are written by experts in their several fields and designed for the lay reader. It is hoped these are doing something to bridge the gap between high-school history and university research and they have now become popular for high-school and university courses in Canadian history. The profits from what was once a non-profit enterprise are being plowed back into making more booklets available. The Canadian Historical Association likes to think that this is at least one service it can give the country.
15. It may be able to give more. It can play a stronger role in the allocation of funds to historical journals, in administering publication grants, and in strengthening the professional contacts among historians in Canada. One conspicuous success recently has been the Centennial Seminars of 1966 and 1967, where it administered Centennial Commission funds. It managed this, as it manages its whole operation, on the basis of the good will of dedicated scholars and researchers who simply take the extra time to do what has to be done. At present the Canadian Historical Association operates without a permanent secretariat, and is currently considering the necessity of such a step, either on its own, or in conjunction with other learned societies. Once a permanent secretariat is established, it should be able to generate more energy and use it more purposefully.

16. Priorities that the Canadian Historical Association would like to see for the future can be summarized:

I. Archives of Canada

1. Broader support for acquisitions, especially for staff to screen records coming from government departments, and firm assurances that departments would turn over their full records to the Archives. Only there are they fully available.
2. Broader policies for Archives acquisitions, to include institutional records in the whole range of social history, and to include also non-written records, films, radio and TV broadcasts, recordings from oral history projects.
3. Support for the microfilming of European records relevant to Canada, especially those in England and France.
4. Support for the Archives publishing programme. They are now publishing the writings of the Prime Minister of Canada. The first volume of Macdonald's letters is just out, and well done; but the programme has a long way to go and it should have the full support of the Government.

II. The Canada Council

1. Extension of support for the travel and maintenance of scholars to and from their centres of research.
2. Continued and expanded support for the travel of scholars to academic meetings.
3. Continued and extended support for scholars on sabbatical leaves.
4. Support for the publications programme administered through the Humanities Research Council of Canada and the Social Science Research Council of Canada.
5. Extension of aid to the learned journals.
6. Especially vital is much wider support for library acquisitions.

Special Committee

III. Historic Sites and Monuments Board of Canada
 Comprehensive and systematic expansion of its
 work and its powers.

All of which is respectfully submitted,

The Canadian Historical Association,

P.B. Waite

P. B. Waite
 President

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W. I. Smith, Public Archives of Canada, Ottawa, Ont.

APPENDIX 125

BRIEF

TO THE

SENATE SPECIAL COMMITTEE

ON

SCIENCE POLICY

SUBMITTED BY

THE HUMANITIES RESEARCH COUNCIL OF CANADA
LE CONSEIL CANADIEN DE RECHERCHES SUR LES HUMANITES

Special Committee

BRIEFTO THESENATE SPECIAL COMMITTEEONSCIENCE POLICY1. The Humanities and Government

The Humanities Research Council of Canada (HROC) appreciates the wide ranging interest in "Science Policy" which this Committee has expressed. Though the Humanities do not appear superficially to receive much attention in the formulation of government policy, many of their precepts so underlie the basic assumptions of the political system that their importance has been overlooked.

In this Brief the Humanities Research Council will emphasize the need for a broadly based input for a Canadian Science Policy -- an input that can give due weight to the contributions which Canadian humanists can make. Though the HROC is largely concerned with the means of supporting research in Canadian universities in the Humanities, it is aware that the interest in these subjects ranges throughout the whole society.

The Humanities provide the structure for the fruitful use of the imagination. Through the process of inquiry and research the Humanities encourage both imagination and learning. The Humanities are not easily susceptible to the disturbing rationale that the returns on investment must be seen to be of a practical and economic nature. In the field of human knowledge we are spurred on by a natural craving for knowledge and investigation. Often "people are too prone to torment themselves with devising far-fetched reasons"¹ for studying even the Humanities. "Let a man", Houseman continues, "acquire knowledge not for this or that external and incidental good which may chance to result from it, but for itself; not because it is useful or ornamental but because it is knowledge, and therefore good for man to acquire."²

1. A.E. Housman, "Introductory Lecture" (3, October 1892) in John Carter (ed.), A.E. Houseman Selected Prose, (Cambridge, 1961); p. 16.
2. ibid. p. 18

Though the HRCC recognizes the current importance of devising "far-fetched" reasons, it sees even more clearly that, because of present emphasis, especially in government, on gaining useful knowledge, there is all the more reason for encouraging the pursuit of knowledge for its own sake.

At the same time we should point out that such aspects of the Humanities as the study of linguistics, history, and religion can be seen to bear directly on society at large.

2. Support for the Humanities

It might be useful to recall the situation which provided the impetus for the organization of the HRCC:

Prior to 1942, the humane disciplines in Canada had never been organized or able to speak with a corporate voice. In the autumn of 1942, it was learned that a proposal to discontinue Arts studies for the duration of the War was to be considered in January 1943 by the Federal Government. A small committee of the Royal Society of Canada, acting under the chairmanship of Watson Kirkconnell, prepared, after wide-spread consultation and correspondence, a memorial to the Prime Minister, urging that, on the contrary, everything possible should be done to strengthen the position of the humanities in higher education. The Government decisions of January, 1943, gave Arts instruction a generous reprieve, but the sense of danger remained.³

The Council's interests, thus begun, led naturally to its encouragement of research in the Humanities. Through the generous support of the Carnegie and Rockefeller Foundations in the United States the HRCC was able to offer Canadian humanists support for their research activities. In 1957 with the establishment of the Canada Council much of this funding work was supported and later assumed completely by the Canada Council.

In presenting this Brief we, as representatives of the Humanities Research Council of Canada, want to recognize publicly the beneficial support which the Canada Council has given to Humanities research in Canada.

The increase in the support given to the Humanities and Social Sciences by the Canada Council since 1964 was long overdue.⁴

3. First Report 1943-1947, Humanities Research Council of Canada (n.d. Humanities Research Council of Canada; Ottawa), see also Watson Kirkconnell, Introduction, in R.H. Hubbard (ed). Scholarship in Canada, (Royal Society of Canada, 1968, Ottawa), p. x.
4. Appendix "1", The Canada Council Social Sciences and Humanities Programme, in The Senate of Canada Proceedings of the Special Committee on Science Policy, No. 1, p. 30.
 1964-65 - \$ 1,403,000.
 1965-66 - 3,117,000.
 1966-67 - 5,838,000.
 1967-68 - 11,614,000.
 1968-69 - 17,188,000.

At the present time (1968-69) the Canada Council in their Annual Report estimates that the graduate enrollment in Canadian universities in the Social Sciences and Humanities is 16,200, some 55% of all graduate students enrolled. Though it is estimated that this percentage may remain constant, the actual enrollment will increase to almost 28,000 graduate students in 1972-73.

This rapid increase,⁵ similar to that of the last four years, has serious implications for the funding of research, not only for doctoral students, but especially for professional scholars involved in research in the university community. For this latter group of career scholars the situation is particularly difficult. In many universities, the research funds available, and they are not extensive, often are allocated first to the most junior and "unpublished" members of the faculties.

The Canada Council has noted that "the scholarly community in the social sciences and the humanities is reacting to the climate of our time, which urgently demands intensified research. It is also evident that interest in our programme of assistance is increasing constantly".⁶ Indeed it is.

Beyond the activities of the Canada Council, the interests of the Humanities, as subjects of study and research, have been poorly supported. And yet at a time when government especially seeks specialists in the different fields of its interests, the views expressed to the Massey Commission are still valid:

No one can understand our contemporary world who has not given serious thought and study to both the sciences and the humanities. They develop two kinds of mental capacity and so reinforce the power of both. Science has taught men that the search for truth must be disinterested, exhaustive, tireless. The work of the scientists consists largely in weighing and measuring, and in this strictly limited field his ideals of research find their most fruitful application. He seeks to marshall all the relevant evidence, and in a given case he may feel reasonably sure that he has done so; the truth at which he arrives is independent of place or time as such, and in enunciating it he naturally tends to be

5. Graduate enrollment in Social Science and Humanities in Canadian Universities

1963-64 5,800.

1968-69 16,200.

1972-73 27,800

(11th Annual Report, 1967-68; The Canada Council, p. 50)

6. Annual Report 1967-68 Canada Council, p. 5.

dogmatic. The humanist is much more hesitant about forecasting the future, for he knows that in his field it is almost impossible to assemble all the relevant considerations. He learns to regard dogmatic prophecy as a gratuitous form of folly.⁷

Thus the more the Humanities remain under-nourished, the more the national interest suffers. "What may seem unimportant or even irrelevant under the pressure of daily life may well be the thing which endures, which may give a community its power to survive."⁸

Technological and scientific advances present challenges: humanities and to a degree social sciences must try to provide human (and humane) answers.

The interest of the federal government in the humanities is clearly displayed through the existence of such organizations as the National Library, the Public Archives, the National Museums of Canada, the National Center for the Performing Arts, and, of course, the Canada Council.

One views with alarm the recent public comment concerning the National Museum and the National Gallery particularly, and their restrictive if not penurious budgets. The Canada Council budget too, was reduced for the fiscal year 1968-69. And where, we wonder, are these decisions reached? On what priorities are they based?

Too often we see the Humanities short-changed and not only at the national level. Through its funding of practical, mission-oriented research, largely in the social sciences and natural sciences, the government actually and relatively has been causing a reduction of support for the humanities. Over the last fifteen years a situation, disappointing in 1951, has been allowed to grow worse.

It is gratifying to note that in spite of this serious situation the availability of funds for free, scholar-generated research is growing. In 1966-67 the Canada Council was able to grant 67% of the requests from career scholars in the social sciences and humanities. In 1972-73 the Council estimates that it will meet 74% of these requests for assistance, and the requests themselves will have increased in number almost four times.

7. Malcolm W. Wallace, "The Humanities" in Royal Commission Studies: A selection of essays prepared for the Royal Commission on National Development in the Arts, Letters and Sciences (King's Printer, 1951), p. 116.
8. Report Royal Commission on National Development in the Arts, Letters and Sciences (King's Printer, 1951), p. 4.

Such a programme of development goes far in answering one of the continual concerns of this Council, and the Canadian academic community in the Humanities, namely the funding of research.

But is such support the most valuable to the humanist scholar? Clearly it should assist in producing more scholar generated research, better teachers, and one might hope, in the end, a more sensitive nation.

3. Research Needs in the Humanities

Unlike the social scientists, the humanist does not need to work so closely with the increasing hardware of computers and other equipment. His pursuit of knowledge must take him to far and often ancient parts of the world. His work with books and manuscripts and his time for thought and reflexion provide the important tools of his trade.

For the most part libraries in Canadian Universities fall far below the standards required for adequate support of scholarship and especially of research. Adequate library resources are not only important determinants of the quality and quantity of research; they are vital if Canadian Universities are to attract and hold first class research and teaching personnel. An indication of the pressing needs of libraries is the recommendation of a study completed in September 1967, that additional appropriations totalling \$150,000,000. for collection development will be required over the next decade.⁹ Moreover, if Canadian researchers are to be aided in their work, libraries must be encouraged to keep pace with the rapid technological developments taking place in the concepts of information retrieval. This Council recommends that concentrated efforts be made to establish a nation-wide information retrieval system centered on Canada libraries.

Such a system would greatly aid the research of humanists. However, it could not easily duplicate the unique resources which exist outside of Canada.

Though the mechanical and electrical assistance in research is increasing capabilities in such fields as language study, research in classical antiquities and the study of literatures, more basic research facilities need provision.

9. Robert B. Downs, Resources of Canadian Academic and Research Libraries, (Ottawa, Association of Universities and Colleges of Canada, 1967); p. 6.

It is probably unnecessary to emphasize again the ultimate value to the Canadian people and Canadian intellectual life of a continued and enriched programme of support for the humanities. Research needs support and the dissemination of the results of this research needs support. Finally, the strengthening of relations between Canadian scholars and their colleagues in other countries provides enrichment for teaching and improves the competence of Canadian scholars.

These are goals which the Humanities Research Council has striven to support even with its limited resources. In strengthening the university community, the country's resources are improved.

4. The Sources of Support for the Humanities

Unlike the field of social science, where there is concern with the over balancing of free research by "mission-oriented" projects, in the Humanities, the concern has been with neglect. Funds for free research come only from the Canada Council and the universities themselves. Funds are very limited for scholars in the Humanities. It is highly desirable that funds for research in the Humanities be greatly increased. Additional funds to further assist in communication between scholars are needed. We particularly need help for scholarly journals in the Humanities and to support the meetings of Canadian scholars.

Of particular importance for Canadian scholars are small specialist meetings to review research problems and plan with concentrated effort for new departures in research activities. The difficulties of communication amongst scholars within this country would render such gatherings of major significance.

The observation of the Bladen Commission in 1965 is equally true today: "There has been little evidence of recognition of the gross inadequacy of the funds for research in the Humanities and the Social Sciences, perhaps because the economic yield is less obvious and less certain. The need here is very great if we are to play our part in the civilized world".¹⁰

10. Financing Higher Education in Canada ...; published for the Association (of Universities and Colleges of Canada) by the University of Toronto Press and Les Presses de l'Université Laval, 1965; p. 75.

There are several reasons why there is a rapidly growing need for funds to finance research in the Humanities. The size of the academic community is growing rapidly and an increasing proportion of academics are becoming involved in research. With growth in the number and size of academic institutions research has become a necessary activity in all teaching departments. Moreover, rapid growth imposes strains which make it more difficult for the scholar to find the time and resources to carry on the research of which he is capable. The growth of the academic community may be indicated approximately by the increase in the number of full-time staff in Canadian universities. In 1960-1961, there were 9,755. In 1967-1968, there were 20,700 and the projected increase in enrollment suggests that something of the order of 30,000 staff will be required in 1975-76. These figures, of course, include staff in all disciplines. In 1967-68 more than 50% of university teachers were working in the fields of the humanities and social sciences. By 1972-73 it is estimated that some 18,000 to 20,000 Canadian scholars, or, almost twice as many as are involved at the present time, will be teaching in the Humanities and Social Sciences.¹¹

We have emphasized in this Brief research in itself, apart from its training function. The training of researchers in the Humanities is critical. A well trained research scholar can teach with greater competence and enthusiasm. He can as well be a more useful person should he be called to work outside the university community.

The few sources of support available for humanist scholars are of great concern to this Council. We should like to emphasize the real importance of a variety of sources of research support in the Humanities. No matter how careful and objective the judgement of research applications may be, and no matter how independent and impartial the granting agency may be in its decisions, the fact remains that in the humanities and the social sciences there are a variety of ways of looking at research problems. Some of these new approaches may not yet be acceptable to the academic establishment which is likely to advise on the use of funds: others may deal with topics so sensitive on political or conventional moral grounds

11. Annual Report 1967-68 Canada Council, p. 55.

that granting agencies may be hesitant to back them. In any event, both the humanities and the social sciences involve research innovations which may challenge conventional notions of respectability to the point that a variety of sources of research support will be more likely to take account of all fruitful lines of attack.

It is our firm conviction that only in a variety of sources of research support can we find the true freedom of the researcher to find the support he requires when it is needed. Accordingly, a sound policy of research support from our point of view will not discourage various agencies of government - federal and provincial - as well as private agencies from offering to support scholars who may appeal to their tastes.

We favour a multiplicity of channels through which federal funds may be made available for research as well as through the Canada Council. An increase in the flow of funds through, say, the Canada Council, should not inhibit the flow of funds for research through government departments such as the National Gallery, the National Museums, as well as through the Humanities Research Council of Canada and the Social Science Research Council of Canada.

Such arrangements would certainly provide bureaucratic difficulties of over-lapping jurisdictions. But the multiplicity of sources we would consider a source of strength for the Research community. However, since the programme of the Canada Council and the expansion planned for it seems well in hand, we would strongly suggest the endowment of the Humanities Research Council and its direct assistance by the federal government. This additional opening for the support of free research in the universities could be a major contribution to Canadian scholarship in the humanities.

5. The Need for Strengthened Support of the Humanities

The "Bladen Report"¹² recommended that the Canada Council budget for the humanities and social sciences for 1966-67 should be at the level of \$15 million,¹³ and should be escalated at the rate of 20 percent each year thereafter. Of this total some \$2 million was recommended as grants to university libraries for the development of their research collections.

12. p. 69.

13. The estimated expenditure in the social sciences and humanities programme was, in fact, \$11.6 million.

The Council's budget already sadly lags behind these objectives established in 1965. This disturbing difference between "the recommended" and "the actual" continues to grow, in spite of the rapid increases in the budget of the Canada Council. To further assist the funding of "free", "scholar-generated" research, the HRCC has proposed that it be supported directly by the Federal Government. Such support, in the form of an endowment would give the Council considerable flexibility in sponsoring those activities which are of value within the scholarly community. We note with some envy and apprehension that in 1967-68 the National Research Council committed some \$40 million to the support of Research and Development in Universities. This figure was an increase of \$10 million over the previous year. An allotment in 1968-69 of \$51.4 million is estimated.¹⁴

Compare these figures of the NRC (and they account for less than half of the total budget) with the Canada Council's total budget of \$17.2 million for the humanities and social sciences and the great void is obvious. Canadian scholarship in the humanities and social sciences can only suffer unless serious attempts are made to increase the funds available. Moreover, we believe that this Research Council could play a significant rôle in promoting Canadian scholarship if it has the financial resources to do so.

We suggest that with the addition of funds from federal and other sources, the Humanities Research Council could provide needed support for a variety of scholarly activity.

6. The Humanities Research Council and Consultation with Government

We are convinced that this Research Council should be in a position to aid the federal government through broadly based advice and comment on government plans, programmes and priorities.

This Research Council has viewed with some concern the apparent influence of the Science Council of Canada which seems, in its recent Report #4 Towards a National Science Policy for Canada to establish goals which involve work of greater importance to the social sciences than to the natural sciences, where they are qualified to give advice. The Council is anxious to modify the objective of the Science Council which would see it developing affinities with the social sciences and "possibly even some

14. Appendix M "Financial Information", Brief by the National Research Council to the Senate Special Committee on Science Policy. Proceedings of the Special Committee, #3, October 23, 1968, p. 262.

aspects of the humanities".¹⁵ Which aspects of the humanities the members of the Science Council would want to become involved in, is not made clear. Though we may overestimate the influence of that body, an incident of direct experience is noted here.

Difficulties with the interpretation of the rôle of the Science Council of Canada were experienced when that Council established a project to enquire into the Support of Research in the Universities. When it became clear the Science Council intended to investigate not just the natural sciences research but that in the social sciences and humanities, considerable interest was roused. Through the efforts of this Research Council, the Social Science Research Council of Canada and the Canadian Association of University Teachers, the project was co-sponsored by the Canada Council. With the consequent involvement of the social sciences and humanities, the membership of both the Study Group (led by Dr. J.B. Macdonald) and the Advisory Committee (Chaired by Dr. Roger Gaudry) was modified.

We referred earlier to the involvement of this Research Council as an advisory body for government purposes. The involvement of the Canada Council as a co-sponsor of the project, studying the support of research in the Universities, shows clearly that body's anomalous position. Unlike the Science Council, the Canada Council is not an advisory body. Though the Council is admirably staffed, its position is not one that it can easily advise the government on matters of policy in the social sciences and humanities. "The Canada Council is essentially a bureaucratic organization."¹⁶ That statement sums up the Council's strengths and weaknesses.

This discussion of the Science Council of Canada and the Canada Council has served to point up the very real difficulties which exist in providing the decision making processes of government with the views of the scholarly community in the humanities, and social sciences. We are anxious to ensure, in the most effective way, that the governments of Canada and especially the Federal Government should have the best possible

15. First Annual Report, Science Council of Canada, 1966-67; p. 1.

16. The Senate of Canada, Proceedings of the Special Committee on Science Policy, No. 1, p. 14.

advice presented to them. This can be most effectively presented by scholars in these same fields where governments plan to move. In the case of the HRCC, the Humanities are the major concern.

It seems to us of great importance that, before major policy decisions are made, there must exist an advisory machinery through which the most authoritative advice from humanists can be expressed and taken into account. In 1966 the HRCC through constitutional revision took steps to ensure direct representation of each of the learned societies in the Humanities.

We do not believe that a revised or reshaped Science Council can satisfy these needs. With its secretariat and its membership already deeply involved with the natural sciences the addition of a humanities division could, in our opinion, not be successful.

The principal objective is to have bodies which can speak with authority to the Federal Government -- its departments, and political sectors and the other bodies in Canada and abroad as to the research needs in the Humanities and their priorities. The combined voice of the learned societies in the Humanities speaking through the Humanities Research Council of Canada would do much to facilitate the provision of this advice and information.

It is crucial that the Government be able to evaluate its practices, policies and programmes from various points of view. Broader national interests must receive attention. This Council because of its close relations with the academic community would be able, we believe, to provide the Government's policy makers with sound advice.

APPENDIX 126

BRIEF SUBMITTED TO

THE SENATE SPECIAL COMMITTEE ON

SCIENCE POLICY

BY

THE CLASSICAL ASSOCIATION OF CANADA

Special Committee

BRIEF SUBMITTED BY THE CLASSICAL ASSOCIATION
OF CANADA
TO
THE SPECIAL COMMITTEE OF THE SENATE OF CANADA ON SCIENCE POLICY

The Classical Association of Canada is an association, mainly made up of classical scholars from the universities of Canada, but restricted in its membership neither to the university community nor to Canadians. Its current Honorary President is Mr. Justice Samuel Freedman, and its President, Professor Malcolm F. McGregor, Chairman of the Department of Classics, University of British Columbia. It includes the great majority of members of Departments of Classics throughout Canada and its stated aim is the furtherance of classical studies. This brief has been prepared for the Association by Professor C.D. Gordon, Chairman of the Department of Classics, McGill University in consultation with the Council of the Association. The Association does not ask to appear before the Committee but Professor Gordon is willing to do so if the Committee so desires and will submit his curriculum vitae at that time.

PREFACE

1. The Classical Association of Canada is well aware of the generous grants which have been made to individuals by the Canada Council; but it is our impression that it is easier for a young scholar to get a grant for a specialized short-term project than for mature men to obtain funds for large scale projects which might last many years. This should and easily could be corrected by the granting agency. This brief, however, concerns itself not with help to individuals for their specialized research but with ideas on how to raise the general level of research work in Canada. In summary the Association therefore submits that the further research needs for scholars at large are as follows. They are listed in an approximate order of priority and urgency.

(A) Funds on a generous scale for specialized collections of books for university libraries and a periodically revised inter-library catalogue of such collections available in many centres throughout the country. The provision of these collections of specialized material should not be confused with the equal but different needs for general library funds.

(B) Increased financial assistance for the production of books, monographs, and journals, especially those of a peculiarly expensive kind, as vehicles for the publications of Canadian scholars and as magnets for top scholarship abroad.

(C) Financial support for seminars for senior scholars in specialized fields of classical research.

(D) Travel funds on a more generous scale to enable all scholars to attend meetings of learned societies in the various fields of interest to classicists both national and international.

(E) Funds to enable universities to start modest collections of archaeological, papyrological or numismatic material for research (and teaching) purposes.

(F) National centres in Rome and Athens where classical scholars would work and meet each other.

(G) Funds at least to plan facilities in Europe for field training in archaeology. These funds might act only as "seed" money for the beginning of inter-university excavations financed by other than governmental sources.

1. It is of concern to many people that the Committee in enquiring into the research needs of science and social science disciplines seems to be overlooking the no less real needs of the humanities, and this is rather hard to understand considering the close interrelationship between many of the so-called humanities and the so-called social sciences. The study of Classics as understood in Canadian universities embraces the interests of all humanities and of many disciplines outside, in that in addition to the literature of Greece and Rome, the classicist may be interested in problems of history, anthropology, architecture, philosophy, art and archaeology. While this submission, therefore, pertains only to Classics many of the points raised may be taken as also applicable to the humanities at large.

The study of Classics is concerned with the study of all aspects of ancient society and has in the past spawned many studies which have developed into full-fledged social sciences in their own right. To take only the most recent example of this phenomenon the study of linguistics has spring in most cases from departments of Classics to become separate departments in many universities. In any case to understand the present world fully needs the perspective of history reaching as far back as possible, and for our own society that means going back to our roots in Greece and Rome.

2. It is taken for granted in the sciences that without research the standards and reputation of a science department are low. This should also be considered true of a Department of Classics. In the first place the teacher who is at the growing edge of man's expanding knowledge of his past is one who can best inspire his students with the zeal and enthusiasm which are the driving power in his self-education. It follows that the best teachers are those who are interested in research; these are the ones we want to attract to Canadian universities. But the academic world is competitive and a university which does not maintain its research facilities will cease to attract good teachers and enrol good students. Without increased research funds Canadian Departments of Classics run the risk of drifting into mediocrity as mere service departments instead of contributing on their own to the vitality of their universities.

3. It is notoriously difficult to define "research" in the humanities. There are

at least two separate aims of research in Classics. There is discovery of new facts relating to antiquity through archaeological, epigraphic, numismatic work and through the rather rare discovery of long lost manuscript material. Of equal importance is the reinterpretation of ancient literature and history in the light of contemporary insights sharpened and focussed by such diverse fields as psychology, sociology, economics, demography and medicine. This is the sort of interaction of disciplines that is most productive of heightened understanding of the human condition, which most benefits society today and which will be of increasing importance to the leisured society of the future.

4. The financial needs for research in Classics are modest compared to those of the biological or physical sciences. We need no elaborate equipment or separate research installations but there has grown up an unfortunate distinction between what might be called the tools of discovery and the tools of communication. The tools for research in Classics are primarily books, but, all too often when research support is being discussed and appeals are made for additional library funds, the answer is made that support for libraries is another and separate problem. For the Classics it is not. If a man wants to do research on Ptolemaic government, original papyri documents are, of course, useful, but far more important to him are the documents already published in long series of expensive volumes. The prime need, therefore, for research in Classics is for certain types of publications. These are apt to be expensive and there is no need for duplication in Canadian universities; wherever these are collected they should be considered a national resource available to scholars anywhere in the country and catalogues of them should be interchanged among University libraries. This applies particularly to highly specialized fields such as Palaeography, Epigraphy, Papyrology, Numismatics and Byzantine Studies. The National Library and the system of inter-library loans is helpful as far as they go, but the real need is, as was mentioned, a consolidated catalogue available easily in many regions of Canada so that scholars anywhere can easily find rare or expensive books.
5. A start in this direction has been made in Toronto with an exceedingly modest grant of \$7000 from the Canada Council but many times this amount is needed to create even one or two first class research centres in different regions of Canada, to say nothing of raising the general standards of Classics collections in all universities.
6. If books are tools of communication so also are scholarly publications and meetings of scholars. The Canada Council has generously helped in the printing costs of Phoenix by annual grants now amounting to \$5000. This, the

Journal of the Classical Association of Canada, has now become a publication highly respected in all parts of the world. It is the chief vehicle for communications by Canadian Classical scholars but financial problems still limit its size and scope, hinder the printing of articles calling for expensive plates and force the editorial staff who bear the grunt of administrative and clerical work to restrict their own scholarly research. It is probably the only learned journal in Canada whose editorial staff serves unpaid. Since Phoenix cannot now possibly publish all the worth-while articles submitted to it, there is felt a growing need for a new publication dedicated particularly to publishing work in the growing areas of interaction between the Classics and the newer disciplines. Furthermore, there are not available sufficient funds for the publication in Canada of scholarly books of a peculiarly expensive kind, those calling for many plates or rare type faces such as the Mycenaean syllabary.

7. Seminars for senior scholars, such as that offered by the American Numismatic Society in New York, are needed in such fields as Papyrology, Archaeology and Palaeography as well as in Numismatics. These meetings, however, are expensive and to do their job properly need separate governmental subsidies since the present system of grants to individual scholars does not cover such types of activity. The material necessary for such seminars is already available at some centres in Canada; what is needed is to take full advantage of it by awaking Canadian scholars to its existence and value. More generally funds should be made more generously available for attendance at scholarly gatherings such as the annual meetings of the Classical Association of Canada and the important North American Associations. Some more financially fortunate universities can afford to send members of their staffs to these meetings to talk to and exchange ideas with their counterparts elsewhere. Others, however, grant help only to individuals who are either officers of the association meeting or who are giving papers. This is peculiarly unfortunate for keen junior staff members who are unlikely to fall into either category and therefore miss the intellectual stimulation arising from meeting other scholars of similar interests. A little help in this direction is given by the Canada Council for meetings in Canada, but much more is needed in a country like ours where classical scholars are apt to be very widely scattered; and funds are also needed, where none are now given, to enable representative scholars to attend international gatherings.

8. There are also needs in many places for additional funds for museums or collections of material of classical antiquity. In many cases even modest collections of coins or Greek pottery or squeezes of Greek inscriptions or other artifacts can not only stimulate research in these fields but are of quite extraordinary value in classroom instruction. The discovery, recently, at McGill University of a long mislaid collection of only some 2000 Greek and Roman coins has inspired two members of the staff to investigations in numismatics which would never have begun if only pictures in books had been available. Now, however, this newly awakened interest is rather thwarted by the University's inability to finance the purchase (or find a donor) of one of the few important private collections of such material in the country, a collection which may be lost to American buyers and American scholars for want of about \$50,000. This is, by present standards, a small sum compared to the grants made to pure science. Other types of archaeological material are available at much cheaper prices since private collectors do not compete for it, and yet this material has much to tell the trained scholar about ancient economics, trade, religion and life in general.
9. There is also need for facilities for field training in archaeology and headquarters for Canadian scholars working in Italy and Greece such as are available to scholars from other countries. Some expeditions, such as the University of New Brunswick's expedition to Turkey and Laval's excavations in Cyprus, already exist but other similar projects should be initiated for scholars at other universities and financed on a national basis. The University of Alberta and McMaster have actively expressed an interest in a centre in Rome for Canadian classicists, and are hoping that one recently announced by Ottawa will be something more than just a hostel: it should be national in scope and name, with a good library of its own so as to free Canadian scholars from dependence on the British School at Rome or the American School of Classical Studies at Athens for all their resources and amenities. Even the planning of such excavations or centres would need financial help before any detailed application for funds could be made.
10. By and large it can be said that research in the Humanities has been practically without funds. A fairly typical statistic is that at McGill

in 1963 - 64 the Humanities received only 2.1% of the total research funds spent by the university, and 80% of this was given to the Islamic Institute. It is the hope of the Classical Association of Canada that greater research resources will be put at the disposal of its scholars, resources commensurate with the increasing importance of the humanities in a society with increasing leisure in which to explore the aspects of humanity not concerned with the technology and economics of daily life.

APPENDIX 127

BRIEF SUBMITTED TO
THE SENATE SPECIAL COMMITTEE ON
SCIENCE POLICY
BY
THE ASSOCIATION OF CANADIAN UNIVERSITY TEACHERS
OF
ENGLISH

BRIEF SUBMITTED TO THE SENATE COMMITTEE ON SCIENCE POLICY BY THE
ASSOCIATION OF CANADIAN UNIVERSITY TEACHERS OF ENGLISH, RECOMMENDING
MORE ADEQUATE AND MORE EQUITABLE SUPPORT OF RESEARCH IN ENGLISH
LANGUAGE AND LITERATURE

Preliminary statement

It is assumed by the members of the Association of Canadian University Teachers of English that the Senate Committee's terms of reference do not preclude the receiving and considering of briefs from corporate bodies of Canadian scholars in disciplines other than the natural and physical sciences. This assumption is not based on the notion that by virtue of its origin the word "science" (scientia, from scire, to know) ought to be understood as embracing all knowledge, without prejudice or exclusion; nor will an attempt be made to demonstrate that the humanities, including English literature and language, are "sciences" in the modern, restricted sense of the word, though it is true that, like biology, physics, chemistry, and the other exploratory disciplines, they require precision, sound judgment, recognition of relevant evidence, and in some cases computer techniques. All departments of learning have a common objective, the search for truth in one or another of its manifestations; while the materials and some of the research procedures differ, investigations in all disciplines are directed toward determining what is and what is not, toward discovering what is significant and what is not significant, toward finding evidence that supports a theory or refutes it, toward making some contribution to man's sum total of knowledge of the universe, including man himself and the products of his creative spirit. Viewed in this light, the intensive studies and productive research in which Canada's numerous professors of the humanities engage surely deserve recognition on the same basis

as the investigations of Canadian researchers in the experimental and social sciences. It is the purpose of this brief to draw particular attention to the achievements, opportunities, and needs of those many Canadian scholars who are actively engaged in research in the history and criticism of English poetry, drama, fiction, and belles lettres generally, whether published in Canada, in the British Isles, in the United States, in Australia, in New Zealand, or elsewhere.

It is not always recognized that literary research thus far has not by any means answered all the questions concerning the genesis of great literary works, questions about the social, personal, economic, psychological, literary, and aesthetic forces that brought them into being and gave them their distinctive shape, substance, and imaginative appeal. It could be argued that scholarly research in these manifestations of the human spirit, like "pure" research in the experimental sciences, is justifiable for its own sake and as a function of man's everlasting quest for the truth; it can also be justified as both a stimulus to the nation's progress toward intellectual maturity and a symptom of that progress. Recognition of Canada's intellectual capabilities and resources by other nations of the world is growing; comparable recognition by Canada herself should not be withheld, though popular support -- and therefore government support -- is usually given with less reluctance to projects of research that seem to have a more direct bearing upon the safety or the prosperity of the nation than to the less spectacular (and less costly) research in the country's precious heritage of literature.

Achievements

To measure the quality and quantity of Canadian contributions to knowledge in the area of English literature one needs only to look at (a) the record of publications and (b) the international reputation of the scholars themselves. The most trustworthy, most ample, and most easily available lists of scholarly publications by Canadians are in The Humanities in Canada (published for the Humanities Research Council of Canada by the University of Toronto Press in 1964) and The Humanities in Canada: Supplement to December 31, 1964 (published for the Humanities Research Council of Canada by the University of Toronto Press in 1966). In those two substantial volumes it will be seen that much space is given to listing publications, works in the press, and projects in hand -- more in English, in fact, than in any other subject. It will also be observed that the scholarly books, pamphlets, articles, and reviews published by Canadians working in English literature and language embrace the widest possible range of topics, both Canadian and non-Canadian. If a similar list covering the past four years were available it would show an even more impressive range of research, publication, and other scholarly activity. Large numbers of Canadian scholars have been invited by distinguished publishers both here and abroad to prepare editions of important literary works, have contributed to encyclopedias published in other countries, have done and are doing important work in bibliography, and have made scholarly contributions to the world's knowledge of a multitude of authors in all periods. Testimony to the international reputation of Canadian scholars can be found in the fact that they continue to participate in numerous

international congresses (for example, the triennial conferences of the International Association of University Professors of English, on the Consultative Committee of which there is a Canadian representative), they are members of and hold office in various international societies primarily concerned with research, they have been invited to contribute substantial sections to the New Cambridge Bibliography of English Literature (the most distinguished bibliographical reference work in the English language), their books have an honoured place on the open shelves in the great circular reading room of the British Museum, and they serve as visiting professors or special lecturers at many universities in the United States, in the United Kingdom, in New Zealand, in Australia, and elsewhere.

Opportunities

In addition to the research which, with the help of microfilm and xerox, many Canadian scholars in English are able to do in whatever time they have free from university teaching, there are numerous investigations, such as those enumerated by Dr. W.C.D. Pacey in "Areas of Research in Canadian Literature" (University of Toronto Quarterly, XXIII (1953-54), 58-63), which still await attention; and there are even greater opportunities for research in the literatures -- British, American, and non-English -- which have powerfully influenced our writers and the reading public. It is good for Canadian scholars to examine with great thoroughness the creative writings of their fellow countrymen; but for the ensuring of proper critical perspectives and for the application of the highest standards it is imperative that comprehensive and intensive studies be made of the ideas,

structures, idioms, and -- in a word -- genius of literature produced elsewhere and in other times than our own. There are also opportunities for the initiating of co-operative research projects, some of them involving other disciplines. While some of these opportunities have been recognized already, there are others that have been hampered by lack of books, lack of time, lack of opportunities for consultation with distant colleagues. Such venturing beyond the local horizons is just as necessary in English studies as it is in geology, chemistry, physics, and biology, if research is to avoid parochialism and wasteful duplication of effort.

Needs

As was suggested in the preceding section of this brief, what is seriously impeding research in English language and literature is not any lack of keen and competent members of university departments; it is lack of time, lack of indispensable research material in the very limited libraries of this nation, and lack of opportunity for consultation and collaboration with other investigators in the same field. All of these impediments can be removed -- or considerably reduced -- if ample funds are provided; and it is clear that the universities cannot provide them. It is obvious that the encouragement and financial support of promising young Canadian candidates for masters' and doctors' degrees must continue and increase if highly qualified instructors are to be provided for the rapidly increasing numbers of undergraduates in Canadian universities, and that is an area in which the Canada Council, the Humanities Research Council of Canada, and some

provincial governments have achieved a magnificent record with their programmes of fellowships; but the Association of University Teachers of English believes that it is just as urgently necessary to give encouragement and financial support to the scholar who already has his advanced degree and has an appointment in a university department, for if he is enabled to continue his research activity beyond the level of a doctoral dissertation his work with students will be more stimulating and he may very well produce significant contributions to knowledge. Such a person -- and there are hundreds of such persons in Canada -- must have time for concentrated application to his research project and access to the basic materials of that project. For research in English the basic materials are books, pamphlets, manuscripts, early periodical publications, and the files of twentieth-century learned journals. It is a regrettable fact that for many important projects of research those materials can be found only in the libraries of other countries. Respectable research in literature is impossible unless the investigator has before him all the relevant texts, and that means he must either consult them in the library of his own institution or visit the libraries where they are, unless microfilm or xerox copies are available and satisfactory for his purposes. Libraries are to the researcher in English literature what laboratories are to the researcher in the experimental sciences, and there is no valid reason why a modern, wealthy, and progressive nation should not invest as much money in research libraries as in research laboratories.

In more detail the specific requirements of a Canadian scholar who is both eager and competent to engage in serious research in English are these:

- (a) massive increases in library holdings in his own and neighbouring institutions, plus bibliographic services for the swift locating and borrowing of books and periodicals;
- (b) funds larger than those now available in most Canadian universities to permit him to visit other libraries in Canada or elsewhere in search of materials related to his investigation but not otherwise obtainable;
- (c) funds for the purchase of microfilm and xerox copies of unique manuscripts and printed works required for minute study;
- (d) funds to permit participation in special seminars at other institutions and to permit consultation with other scholars who are aware of the problems and involvements of his own research;
- (e) a lightened teaching load during the particular span of months when he is actually writing for publication;
- (f) freedom from the financial necessity of teaching a summer school class when he should get on with his research and writing;
- (g) an up-to-date account of research activities by other scholars in Canada and elsewhere, a need only partly met by the present bibliographies, which seldom mention work in progress;
- (h) clerical assistance, typewriters with special characters, tape recorders, computer time, facilities for "blowing up" selected frames of microfilm, and certain other time-saving aids to research.

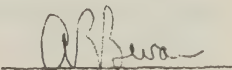

Some of these requirements are now being met in a modest way at some universities, which have been able to allocate limited funds to these purposes. The most pressing need is for rapid and very substantial

building up of library holdings in every Province of Canada and in the National Library.

Recommendations

1. The Association of Canadian University Teachers of English urges the Senate Committee on Science Policy to recognize the propriety of this brief on the ground that "science policy" can and should and does include a concern for the adequate support of research in English literature and language as a substantial and important element in that group of disciplines known as the humanities.
2. The Association of Canadian University Teachers of English requests the Senate Committee on Science Policy to transmit to the Federal Government, the Provincial Governments, Canadian foundations, private benefactors, and the nation's large commercial, financial, and industrial organizations firmly worded recommendations for the establishing and maintaining of a fund which will be adequate to meet the needs enumerated in the preceding section of this brief and commensurate with the support of research in the other areas of learning.

This brief is respectfully submitted on behalf of the Association of Canadian University Teachers of English by its President and Secretary.

 President
 Secretary

Department of English
Dalhousie University
Halifax, Nova Scotia
February 10th. 1969.

APPENDIX 128

A BRIEF TO THE

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

Submitted on behalf of

THE CANADIAN COUNCIL OF TEACHERS OF ENGLISH

by

The CCTE Committee on a Canadian Science Policy

Merron Chorny, Faculty of Education
The University of Calgary, Chairman

Jack Cameron, Faculty of Education, The University of Calgary
Al Kahanoff, Henry Wisewood Senior High School
Allan MacRae, Lord Beaverbrook Senior High School
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Calgary, Alberta

SUMMARY

1. This submission is concerned with English as language and, in this context, as one of two main languages of instruction and study in Canadian schools.

2. The success of a national science policy in Canada is fundamentally dependent upon the proficiency in English of all who are directly affected by that policy. English as a language of instruction is also basic to the education of all those who engage in scientific activities. For these reasons a national science policy should reflect a concern for improving the teaching of English and should facilitate action for such improvement.

3. Improvement in the teaching of English in Canada is urgently needed and must be undertaken on a national scale. For reasons of feasibility, economy and efficiency, as well as for the national interest, federal support is requested for the actions proposed. The recommendations constitute a program of action which is put forward as the most rapid means of making the greatest advance for improving the teaching of English in Canada.

4. Recommendation 1: That federal support be provided for a survey of the state of the teaching of English in Canada.

The survey, proposed for 1970, would provide data for identifying the most urgent problems and would provide guidelines for the immediate steps to be taken to improve the teaching of English.

5. Recommendation 2: That federal support be provided for a national conference to determine new directions for the teaching of English in Canada. The conference, proposed for 1971, would consider new developments in terms of which it would draw up guidelines that could be used for developing new programs in English and improving instruction within and by the existing provincial jurisdictions.

6. Recommendation 3: That federal support be provided for a program of inservice institutes to improve the teaching of English. To be initiated as a pilot program of five summer institutes in 1971, and planned in terms of the needs

identified by the survey, then expanded in 1972 in terms of the guidelines provided by the conference, the institutes would offer courses to improve the competence of teachers of English. The institutes would be conducted at and offered by Canadian universities, which would first submit proposals for approval.

7. Recommendation 4: That the Federal Government establish a foundation to support research in the teaching of English Research in the teaching of English in Canada has been severely limited because of lack of funds. Yet, in any program of improvement, a parallel program of research is vital. The foundation would make such a program possible.
8. Recommendation 5: That federal grants in aid of travel to attend professional meetings and to participate in exchange programs be made available to professors involved in English Education and to selected teachers of English. This recommendation recognizes the importance, for the exchange of ideas, of participation in professional conferences. It would provide for professors of English Education the assistance now available to persons in the humanities and the sciences. The assistance to teachers would consist of a specified number of grants to be made annually to outstanding teachers of English in the country and would be awarded on a regional basis.
9. Recommendation 6: That federal support be provided for a national information retrieval center for English. By gathering information on the teaching of English and making it readily accessible to teachers, the center would further stimulate the exchange of ideas and would facilitate their implementation.

I. THE CANADIAN COUNCIL OF TEACHERS OF ENGLISH

1. The Canadian Council of Teachers of English (CCTE) was formed in August, 1967, to improve the quality of instruction in English at all educational levels; to encourage research, experimentation, and investigation in the teaching of English; to facilitate professional cooperation of the members; to hold public discussions and programs; to sponsor the publication of appropriate articles and reports; and to integrate the efforts of all those who are concerned with the improvement of instruction in English. Membership in the Council is open to all persons engaged in the teaching and supervision of English at any school level and to all others interested in the improvement of such teaching.

2. In this respect, CCTE meets a distinctive need in Canada. Prior to the Council's formation, no specific national professional organization existed to serve teachers of English at all levels. There was no permanent structure within which teachers and scholars could meet to exchange and explore ideas. There was no national body which could promote research or serve as a clearing house for information. There was no regular publication through which teachers of English could communicate or become informed about promising developments in theory and practice. In order to keep professionally informed, some 2,000 Canadian teachers of English had become members of the National Council of Teachers of English in the United States. However, that organization, although it provides valuable service to its Canadian members, could not be expected to become involved, and indeed scrupulously and properly avoided involvement in issues which might be uniquely Canadian. CCTE provides the possibility for Canadian teachers of English, from elementary school through university, to work cooperatively toward the improvement of education of youth in this country.

3. In the eighteen months of its existence, CCTE has grown and has commenced service. It now has almost 800 members. In addition, seven provincial associations of teachers of English, from British Columbia to New Brunswick, as well as the Association of Canadian University Teachers of English, have affiliated with the Council.

4. The First Annual Conference of CCTE, held in Calgary,

Special Committee

August 21-24, 1968, drew 560 registrants, from all the provinces, from twenty states, and from England. Except for two grants in aid of a social function and the costs of printing, the Conference was self-sustaining financially. One measure of the response to CCTE is that all members of the Conference planning committee and all program participants contributed their services without any remuneration, not even toward expenses. Plans are already at an advanced stage for the Second Annual Conference, to be held in Fredericton, August 20-23, of this year.

5. Publications have also been established. The first issue of the CCTE Newsletter (3,000 copies) was printed in March of 1968. The first of two 1969 issues will appear in April, and by 1971 the Newsletter is scheduled for quarterly publication. The first issue of the official magazine, The English Quarterly (2,000 copies), was published last June, and the second issue, last January. A third issue is being prepared for May. Present plans call for two issues of the magazine to be published in 1969, three in 1970 and for the publication to become a quarterly in fact, in 1971. To implement the plan, grants-in-aid of publication have been sought from Canadian foundations. However, only The McLean Foundation has responded with a grant of \$1,000.00 per year for the next three years.

6. To date, the main thrust of CCTE activities has been in the area of information, with an emphasis on conferences and publications. With the expectation that these activities will be firmly established by the end of this year, the Council is planning to turn its energies to the areas of research, development, data collection and education in English, areas which need urgent attention in this country. In terms of the human resources necessary to undertake and direct these activities, CCTE is already rich. However, the possibility of undertaking these activities and of attaining success in them will be determined by the availability of financial resources, and in this respect, the Council is severely limited. It is against this background of experience and expectation that the Canadian Council of Teachers of English makes this presentation.

II. ENGLISH¹ AND A NATIONAL SCIENCE POLICY

1. The success of a science policy in any country is fundamentally dependent upon the language proficiency of all who are directly affected by that policy. Whether the expectations for research and development, and for data collection and dissemination, are realized, will be determined largely by the extent to which the persons involved are articulate in speech and writing and competent in listening and reading. It would seem to be self-evident that the science policy of a country should encompass a concern for a language which is basic to that country's scientific activity. English, as a working language of this country, is basic to the full realization of the objectives of a national science policy in Canada.

2. Similarly, English as a language of instruction in our schools has real importance for a national science policy. English, in this context, is fundamental to learning, whatever the subject. If a student cannot read accurately and write clearly and coherently, he is not likely to progress very far in science or in mathematics, or in any other subject for that matter. Ultimately, the quality of English teaching in the schools influences the level of education that the student attains and the level of competence at which he is able to function. And the level of competence at which he functions within a science policy is of considerable importance to the nation.

3. English as a language of instruction in our schools has importance for a national science policy in yet another sense: A national science policy is concerned with the economic resources of a nation, and education is a factor in economic growth.²

¹This brief is concerned with English as language and, in this context, as one of the two main languages of instruction and study in Canadian schools. It is highly probable that the conditions described and the recommendations made may be as relevant to the teaching of French in Canada as they are to the teaching of English. However, the Canadian Council of Teachers of English cannot assume to speak for the teachers of French in this country, and in all propriety, would not presume to do so.

²Gordon V. Bertram, The Contribution of Education to Economic Growth (Ottawa: The Queen's Printer, 1966).

Comparable data for Canada and the United States suggest that,

although high school attainment has been rising in Canada over recent decades, it has tended to fall progressively below comparable attainment in the United States. (3)

Even with the recent trend toward a more rapid rise in the stock of education in Canada, says Bertram,

. . . it would nevertheless require years to narrow the gap between the two countries for the labour force as a whole to any significant degree. An acceleration of this process would be possible only through sustained efforts to raise the average education of young people in Canada to even higher levels (4)

The success which is attained through such efforts to increase the stock of education will be dependent on the quality of English instruction in this nation's schools.

4. A national science policy is concerned with the human resources of a nation as well. An effective national science policy requires citizens who can think critically and imaginatively, who are articulate and sensitive in their communication, and who have the ability to view scientific activity against a broad background of human endeavor and human aspiration. In the development of social and humanistic values, English in the schools plays a vital role.

5. In the light of the fundamental importance of English to the various aspects of scientific activity, it is imperative that a national science policy reflect a concern for the improvement of the teaching of English in the nation's schools and facilitate action for such improvement. The difficulties posed in this respect by constitutional jurisdiction are recognized. However, the proposals set out in this brief for federal support of certain kinds of action to improve the teaching of English in Canada should not encroach upon essential provincial rights in education. Further, most of the proposals relate to kinds of action which must be undertaken on a national basis and which should complement the activities in the established jurisdictions. To the degree that any of the proposals raise the possibility of federal encroachment on provincial jurisdictions, solutions can be reached by negotiation and agreement. Certainly, there is precedent for such action in Canada.

³ Ibid., p. 23

⁴ Ibid., p. 35

6. Ultimately, the question is one of national interest. The available evidence points to the need for a national effort to improve the teaching of English. However, the means are not at hand. To date, the lip service paid in our country to the needs of English has not been matched by resources which would permit action to be taken. Some persons would claim that in the past decade more has been done by the National Council of Teachers of English in the United States, in a real sense, to improve the teaching of English in Canada--in terms of leadership, guidance, services, publications and exchange of ideas--than has been provided by Canadian governments, provincial or federal.

7. If the teaching of English in Canada is to be improved, direct and immediate action must be undertaken on a national scale. The following sections outline a program for such action.

III. THE NEED FOR A SURVEY OF THE STATE OF THE
TEACHING OF ENGLISH IN CANADA

1. Isolation and lack of the means of communication have impoverished the teaching of English in Canada. Until recent years, except for courses of study and other, irregular publications of provincial governments, there was virtually no means for the exchange of information regarding English programs and instruction. Whatever promise may have resided in programs and developments in one part of the country remained largely unknown to those who taught elsewhere. Even within provinces there was no ready means for the exchange of ideas until provincial English associations, the two earliest formed only in 1960, began regular publications. Nationally, regular communication among teachers of English did not exist until the founding of The English Quarterly last year.

2. With so little opportunity to communicate through publications, teachers of English had even less chance to exchange ideas in national meetings. Geography separated them; no precedent existed for enabling them to convene. It was not until 1967, in Vancouver, that English teachers and scholars from across Canada were first able to come together, to meet with their colleagues from Great Britain and the United States; the occasion was the International Conference on the Teaching of English, sponsored and underwritten by the National Council of Teachers of English (NCTE) in the United States, an organization that had been holding annual national conventions since 1911. And it was not until 1968 that a pattern for annual conferences, to alternate regionally between east and west, was established by the Canadian Council of Teachers of English.

3. This arid condition has left us largely ignorant, nationally, of many things that matter in the teaching of English in Canada. Although reports of provincial Royal Commissions in Education during the past decade have given us some insights; the national picture still remains fragmentary. Information on the relative opportunity that children have to learn English in, say, British Columbia as compared to Prince Edward Island is essentially unavailable. The disparity which may exist between English programs in rural as compared to urban

schools, or among different ethnic groups in Canada can largely be only guessed at. Adequate national data on such matters as the level of preparation of teachers of English, the size of the classes they teach, and on the adequacy of school libraries are largely non-existent. Because of our lack of knowledge about the state of English in Canada, if a crash program were attempted at this time to increase the opportunity for learning English in Canada, immediate guidelines for action would be difficult to determine.

4. Yet, certain available information shows that conditions are not adequate and emphasizes the need for securing such data nationally. In Alberta, a study of secondary school teachers of English⁵ revealed these facts: Although ninety per cent of the teachers had completed four years of university preparation, one-half of them did not possess even four university courses in English. Only sixteen per cent had taken a course in the History of English; only seven per cent had taken a university course in language. Sixty-three per cent reported that they felt insufficiently prepared in the methods of teaching English. On the average, these teachers met 154 students a day; one-half of all the teachers met an average of 186 students daily; nearly double the NCTE recommended load of 100 students. In the light of such student loads, individual attention to students and to their problems in English would be well nigh impossible. The consequences of this situation are that many students do not attain their full potential in language and are limited in their ability to profit from other studies.

5. On the basis of national surveys conducted in 1961⁶ and 1964,⁷ the National Council of Teachers of English reported the following findings about the teaching of English in the United States: Many teachers of English were inadequately prepared for their task. Between

⁵J. D. McFetridge, F. J. Ackerman, G. R. Morisset, M. Chorney, The Professional Load of Secondary Teachers of English in Alberta, 1963-64 (Edmonton: Alberta Teachers' Association, 1965).

⁶The National Interest and the Teaching of English (Champaign: NCTE, 1961).

⁷The National Interest and the Continuing Education of Teachers of English (Champaign: NCTE, 1964).

forty and sixty per cent of the secondary teachers did not possess a major in English. Only one-half of the secondary teachers considered themselves well prepared to teach literature and language; only one-third, to teach composition. In some states, elementary teachers could be certified with little or no preparation in English; the average elementary teacher had devoted less than eight per cent of his college work to English. Inservice education was limited: Elementary teachers with six to ten years experience had, on the average, attended only one summer session. Heavy student loads mitigated against individual attention being given to the development of skill in speaking and writing. In the highest range, one-quarter of the secondary teachers met more than 150 students per day. The average annual expenditure per pupil on school library books was about half the estimated cost of one book.

6. In the United States, these reports aroused a concern about the state of English, provided data which enabled the formulation of guidelines for intelligent action, and led to various kinds of programs, supported extensively by the Federal Government to improve the teaching of English. In Canada, a firm basis of information for any guidelines for similar action is presently non-existent. Yet, it is highly probable that the present conditions for teaching English in Canada are as critical now as American conditions were at the time of the National Interest reports.

7. As a first step toward the improvement of English in Canada, we must assess our present resources for the teaching of English. To this end, it is recommended that the Federal Government provide financial support for the undertaking of a survey of the state of the teaching of English in Canada. Because teachers and teaching conditions are basic to the learning of English, the survey should focus upon these two areas. Specifically, it should inquire into such facets as the level of general preparation of teachers of English, the nature and adequacy of their special preparation in English, the extent of their familiarity with new developments in the field, the degree of their participation in inservice education, the nature of their teaching assignments and student loads, the provision made through

differentiated programs for slow, talented, and other special categories of students; the adequacy of school libraries, the accessibility of other printed materials and of audio-visual aids, the suitability of classrooms, the nature of teacher preparation programs, and the provisions for continuing professional improvement for teachers of English.

8. The Canadian Council of Teachers of English is prepared to help in any way possible, from undertaking complete responsibility for planning, conducting and reporting on the survey, to acting as an advisory body and recommending procedures and personnel.

9. In terms of a schedule for implementing the actions proposed in this brief, it is urged that this survey be undertaken with expectation for completion by the end of 1970.

10. Recommendation 1: That federal support be provided for a survey of the state of the teaching of English in Canada.

IV. THE NEED FOR A CONFERENCE TO DETERMINE

DIRECTIONS FOR THE TEACHING OF ENGLISH

1. The survey will provide data for dealing with most urgent problems in the teaching of English in Canada: it will provide guidelines for the steps which need to be taken immediately to upgrade teachers and to improve teaching conditions. Of equal importance and urgency is the need to determine, in terms of the most promising international developments and the most probable national needs, new directions for English programs in Canadian schools.

2. Recent developments in theory and practice promise revolutionary changes in the teaching of English, equal in importance to those taking place in science and mathematics. Whether the promise inherent in these developments is realized, has significant implications for the national welfare, and, within this context, for a national science policy. The extent to which tomorrow's adults speak, read and write effectively, are articulate regarding their thoughts, feelings and decisions, are able to function professionally and vocationally in science and all other fields,--indeed whether they will be fully realized as human beings and ready to undertake their duties as citizens--will be determined in large measure by the quality of the English programs in Canadian schools.

3. Although action is being taken, particularly by the provincial English associations and by CCTE to disseminate information on new developments to teachers, and to effect changes in existing English programs, the present effort falls pitifully short of the need. The financial resources available are simply not sufficient for the task. As a result, the problems of English in Canada are compounded: Not only is the teaching of English handicapped by probable inadequacies in teaching personnel and conditions, it is also retarded by lack of adequate means of assessing new knowledge in English, of facilitating its dissemination among teachers, and of incorporating it into school programs in the country.

4. This cumulative lag with respect to new developments points to the need to take bold and imaginative action for updating programs of English in Canada. It is not enough merely to seek the best in

existing programs; it is also necessary to look to new knowledge as a basis for projecting dynamic programs for the future.

5. A model for such action is the International Seminar on the Teaching and Learning of English, held at Dartmouth College in New Hampshire in 1966. Co-sponsored by the National Council of Teachers of English of the United States, the National Association for the Teaching of English of England, and the Modern Language Association of America, and financed by the Carnegie Corporation, the month-long Seminar brought together more than fifty scholars and specialists in the teaching of English from the United States, Great Britain and Canada. The object of the Seminar was to review current practice, research and development, and promising new ideas in order to establish a blueprint for English content, curriculum, and instruction for the next two decades. Published only two years ago, the two major reports on the Seminar have the potential to bring about significant changes in English programs and English teaching. However, this is a general blueprint and its relevance has to be considered in the Canadian context.

6. As the second step toward the improvement of English in this country, we must establish guidelines consistent with new knowledge and national needs and objectives, for English programs in Canada. To this end, it is recommended that the Federal Government provide financial support for a national conference to determine new directions for the teaching of English. The participants should be selected for the special and complementary contributions which they can make. They should include scholars from the various areas which constitute English and from related fields; specialists in the teaching of English, provincial representatives who are fully informed about programs, problems, and developments in English in their respective jurisdictions, and representatives of interested professional organizations such as CCTE, the Association of Canadian University Teachers of English, the Canadian Linguistic Association, and the Canadian Speech Association. To bring to the conference the experience of other countries which have already undertaken the actions proposed here, invitations should be extended also to representatives of the National Council of Teachers of English in the United States, the Modern Language Association of America, and

the National Association for the Teaching of English in England. In order to provide adequate time for attaining its objective, the conference should be planned for a duration of three weeks at least. The optimum time for meeting would be summer, when the participants might be free of other commitments.

7. It is further recommended that planning should begin in 1970, and that the conference should be held in 1971, when the report of the survey would be available. Within the terms of this recommendation, the Canadian Council of Teachers of English is prepared to assume responsibility for the conference.

8. This recommendation for a national conference to determine new directions should not be misinterpreted as proposing a national program or curriculum in English; the Canadian Council of Teachers of English believes that there is strength in a diversity of programs. The intent of this proposal is to focus a national effort into providing the best possible guidelines which could be used for developing new programs of English, and for improving instruction in English within and by the existing provincial jurisdictions.

9. Recommendation 2: That federal support be provided for a national conference to determine new directions for the teaching of English in Canada.

V. THE NEED FOR: INSERVICE INSTITUTES
FOR TEACHERS OF ENGLISH

1. The national survey and the national conference will provide the basis for undertaking long-range improvement in the teaching of English. There is need, however, for certain kinds of immediate and complementary action.

2. In the light of such evidence as was cited earlier for Alberta, and for the United States, it can be assumed with considerable validity that a significant number of teachers of English in Canada are inadequately prepared for their task. In the light of this assumption, the institution of an inservice program to improve the competence of these teachers needs to be regarded as an undertaking of the highest priority. In the best of situations in teacher preparation, continuing professional improvement would be necessary; in terms of the best possible assessment of the actual present situation, the need for a program of inservice education must be considered as urgent.

3. In the United States, the report on the National Interest survey, conducted in 1963, drew the following conclusion:

Inadequately prepared to teach English in their preservice education, elementary teachers and secondary teachers of English find few opportunities to acquire necessary knowledge and skill on the job. Appropriate college courses, workshops and institutes in English . . . are not widely available. (8)

That English teachers were prepared to overcome their inadequacies is apparent in the fact that seventy-six per cent of the teachers responding indicated that they were interested in taking a summer or inservice course if financial assistance were available.

4. Recognizing the need identified by the National Interest survey, the United States Federal Government in 1964, provided funds under the National Defense Education Act for summer institutes in English. The provisions included free tuition as well as financial assistance for teachers attending the institutes. By the summer of 1966, the institute program had expanded to the extent that 11,000 English teachers were enrolled. Assuming that each teacher attending

⁸ Ibid., p. 4.

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the 1966 institutes was responsible for 100 students during the subsequent year, then over one million American children profited from improved instruction in English.

5. In Canada, various agencies are undertaking programs of inservice education for teachers of English. However, while specific data is not available, the best evidence suggests that the present effort in this direction falls far short of the need. In general, in the past, certification requirements for teaching in the provinces permitted persons to teach with only one or two years of preparation. Even now the requirement of a university degree for teaching in Canada is the exception rather than the rule. As a result, the greater proportion of English teachers in this country do not have an adequate background. Even though many of these teachers return to university each summer to further their education, their programs do not ensure that they will be brought up-to-date regarding new developments in English teaching. Of the English teachers who have only one year of preparation, a great number simply do not return for further education because their salaries do not permit such an undertaking. And many of the teachers who hold university degrees have not taken refresher courses, in many instances because such courses are not available. As a result, children of this country often fail to attain full competence in their language.

6. The recognition of this problem is not new; neither is the solution. To date, however, there has been too much discussion and too little action. In the national interest, it is now time that someone assumed leadership in a program to upgrade the qualifications of teachers of English in Canada as rapidly as possible.

7. As a third step toward the improvement of English in this country, it is necessary to establish a program of inservice institutes for teachers of English. To this end, it is recommended that the Federal Government provide financial support for a pilot program of regional institutes for teachers of English in Canada, with the view to extending this program in the light of the cumulative experience from the initial institutes. The pilot program might consist of five

regional institutes, one each in the Atlantic provinces, Quebec and Ontario, and two in Western Canada. The institutes would offer courses in the specialized methods of teaching English and in new developments, although some could give particular emphasis to such specific areas as the teaching of composition, speech, and reading.

8. The institutes would be conducted at and offered by Canadian universities. This procedure would respect present jurisdictions in education. Federal funding would be in aid of activities undertaken by institutions of higher learning, already supported by the Federal Government. Proposals for institutes would be submitted by interested universities to a central agency and awards would be made by a board of experts on the teaching of English. A requirement for the preparation of each proposal should be that representatives of both the university and the schools should be involved in all stages of the planning.

9. It is proposed that the pilot program be undertaken in 1971. The experience thus gained will be valuable in subsequent years in designing new institute programs incorporating the guidelines which will be provided by the national conference. The Canadian Council of Teachers of English is prepared to act in an advisory capacity in the establishment of the institute program.

10. Recommendation 3: That federal support be provided for a program of inservice institutes to improve the teaching of English.

VI. THE NEED FOR FUNDS TO SUPPORT RESEARCH
IN THE TEACHING OF ENGLISH

1. The Office of Education in the United States and the Department of Education and Science in England both administer national funds to support research in the teaching of English. In Canada, the need for federal funds for research in the humanities and the sciences has been recognized by the establishment of the Canada Council and the National Research Council. A similar provision for research in education and in the teaching of English specifically, has not been made. Such provincial assistance as might be applied to research in the teaching of English is still severely limited.

2. In the light of the current expenditure on education in this country, and of the importance of English in education, the limited provision of funds for research in these areas does not make sense. In 1962, when the total expenditure on education in Canada exceeded two billion dollars, it is questionable whether the expenditure on educational research equalled one-twentieth of one per cent of that amount. It is inconceivable that an industrial corporation with a comparable annual investment would operate without more realistic provisions for research. When we consider that in the same year the expenditure on research and development in industry constituted one-half of one per cent of the gross national product, we are forced to wonder what value we place on material as opposed to human resources.

3. It would appear that greater recognition is given to the necessity for nearly everything relating to education than to education itself. Since 1960, the Federal Government has contributed over four hundred million dollars to the development of technical and vocational schools in Canada. There is little doubt that considerable research had been undertaken on the materials used in constructing these schools, and on the equipment installed in them. With respect to the teaching of English in these schools, however, no major research was undertaken to try to determine what competencies in language potential employees might expect of the graduates, what kinds of English programs might best develop these competencies, and what kinds of English instruction

might be most efficient in developing them.

4. Implied above are only a few of the many questions facing teachers of English for which answers need to be found. If more effective methods of teaching English are to be developed, if the effort to improve the teaching of English is to be sustained and meaningful, then a broad program of research and development needs to be undertaken. However, present financial resources are inadequate for implementing such a program.

5. As a fourth step to improve the teaching of English in Canada, it is recommended that the Federal Government establish a foundation to provide funds for a national program of research and development in the teaching of English. The difficulties posed in this regard by educational jurisdictions is recognized. However, a comparable difficulty in the United States has been resolved. And in Canada, the establishment of the Canada Council and of the federal program in aid of vocational and technical education are further evidence that such difficulties can be overcome when the national interest is involved.

6. It is important that this recommendation be implemented by an early date.

7. Recommendation 4: That the Federal Government establish a foundation to support research in the teaching of English.

VII. THE NEED FOR GRANTS IN AID OF TRAVEL FOR

TEACHERS OF ENGLISH

1. Participation in conferences and in activities which involve travel are important for professional growth. At the present time, the Canada Council provides grants in aid of travel for English scholars. However, university professors of English Education are excluded from such aid because of the terms of reference of the Council. As a result, the latter group, because they are involved in pedagogy,⁹ are denied assistance for participating in the kinds of professional activities which are recognized as valuable for their colleagues. This limitation contributes to the isolation cited earlier as impoverishing the teaching of English.

2. The advantages of participating in major professional meetings are as important for English teachers as for English scholars. The implementation in classrooms of new ideas in the teaching of English necessitates, first, an exposure to these ideas. In this country, however, there is little tradition for teachers of English attending major conferences. Although some local jurisdictions do recognize the values in such professional participation, most teachers are unable to get grants for travel, and in many instances, are unable to secure permission to attend a conference held during the school term, even when they are prepared to pay their own way.

⁹As program chairman for the International Conference on the Teaching of English, sponsored by NCTE and held in Vancouver in August, 1967, the chairman of the committee preparing this brief attempted to intercede on behalf of members of English departments of Canadian universities who sought grants in aid of travel, from Canada Council, to attend the conference. Although the program featured sequences on linguistics and on world literature and involved outstanding English scholars from the United States and England, the appeal to Canada Council was denied on the grounds that the conference was pedagogical. In the light of the Council's terms of reference, the decision made was understandable. However, it was ironic that Canadian scholars were unable to secure Canadian support to attend a conference which was underwritten by an organization from another country and which, because of its location was to the advantage of Canadians.

3. Valuable, as well, for improvement of the teaching of English is an exchange program whereby a teacher from a school in one part of the country might spend some time in a school in another region to become familiar with a new and promising program, or to study new methods of instruction. To a very limited degree, such exchanges are already taking place. However, the present opportunities are very few. Further, many teachers would be unable to take advantage of these opportunities because of the travel costs involved.

4. In order to further facilitate the exchange of ideas in the teaching of English, it is recommended that the foundation proposed in the preceding section also provide grants in aid of travel for professors responsible for the special preparation of teachers of English in Schools and Faculties of Education and for a certain number of teachers of English. Specifically, the grants to the professors would be in aid of travel to professional conferences and meetings in the area of their interest; to the teachers, in aid of travel to major conferences of teachers of English, and in relation to exchange programs. The latter category of aid would consist of a specified number of grants to be made annually to outstanding or particularly promising teachers of English in the country and would be awarded on a regional basis. A secondary purpose of these grants would be to establish a pattern of action which provincial and local jurisdictions might adopt. Early action should be taken on this proposal.

5. Recommendation 5: That federal grants in aid of travel to attend professional meetings and to participate in exchange programs be made available to professors involved in English Education and to selected teachers of English in Canada.

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VIII. THE NEED FOR A NATIONAL INFORMATION

RETRIEVAL CENTER FOR ENGLISH

1. Lack of adequate means of communication and of information exchange in the past has contributed to present inadequacies in the teaching of English in Canada. To maintain the momentum of the proposed effort to improve the teaching of English, steps need to be taken to provide for a comprehensive, efficient and continuing exchange of information. Although the expanding program of publications of the provincial English associations and of CCTE will contribute greatly to overcoming the professional isolation of the past, this program cannot encompass the range of information exchange that is required. In the light of past experience, it is unlikely that any private agency will undertake this function. And provincial governments, if they were to try to provide the service in the range required, would become involved in costly duplication.

2. It is therefore recommended that the Federal Government establish a central agency for the purpose of gathering and disseminating information--contained in papers, reports, articles and other materials--on the teaching of English. This agency might be modelled on the Educational Resources Information Center (ERIC) in the United States. ERIC consists of a central system with seventeen clearinghouses, one of which, ERIC/NCTE, serves English. Anything that is of interest to a broad range of teachers, from unpublished speeches to book-length studies, and from curriculum guides to reports on the state of the teaching profession, is processed by ERIC. A monthly catalogue gives data on the materials processed. Copies of the materials, photographically reproduced or on microfiche, may be purchased. The establishment of such a system in Canada would bring the world of new ideas within reach of every classroom teacher of English.

3. Recommendation 6: That federal support be provided for the establishment of a national information retrieval center for English.

IX. THE NATIONAL INTEREST, A NATIONAL SCIENCE
POLICY, AND THE TEACHING OF ENGLISH

1. It is in the national interest that a national science policy is established. However, the national interest will not be served unless the people involved in science activities can function within language to the fullest possible extent of their capacity. Whether they will become able to function fully in language will depend largely on the quality of English instruction they receive in the nation's schools.

2. Yet, the limited evidence that is available suggests that the teaching of English in Canada is not nearly as effective as it should be. Low certification requirements for teaching, unrealistically heavy teaching loads, inadequate conditions, insufficient provisions for inservice education, limited facilities for exchange of ideas, and for their introduction into practice, and insubstantial bases for research preclude the possibility of Canada's youth developing their language competence to its full potential. The result is that even the best conceived plans for national development are doomed to only partial success because of the lack of competent personnel for their implementation.

3. If a national science policy is to have a firm base for development, it must encompass a concern to improve the teaching of English and must facilitate action for such improvement. To say that the task can be left to other jurisdictions is to fail to realize the nature of the undertaking. First, action is necessary now. It is unlikely that other jurisdictions will react with the urgency that is needed. Second, the scope of the undertaking exceeds the capability of any single jurisdiction. Third, uncoordinated and unilateral regional action would be uneconomical. Fourth, the problem of English is a national problem. It requires national leadership with provincial cooperation for its solution.

4. The improvement of the teaching of English in Canada requires urgent and positive action. It is vital to the national interest; it is vital to the national science policy which serves the national interest, and it is vital to the education and future of the nation's youth.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

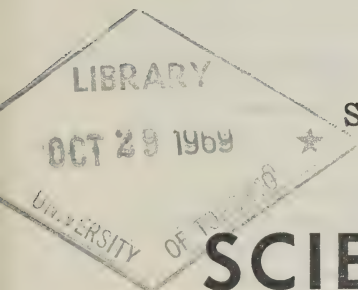
PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY



The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*
The Honourable DONALD CAMERON, *Vice-Chairman*

No. 59

WEDNESDAY, JUNE 11th, 1969

WITNESSES:

Canadian Construction Association: Mr. Mark Stein, President, Mr. J. Cochran, Director, Mr. S. D. C. Chutter, General Manager; Canadian Institute of Steel Construction: Mr. R. G. Johnson, President, Mr. David H. Kennedy, Chairman, Engineering and Research Committee, Mr. Ross E. Chamberlain, Assistant to the Vice-President, Engineering, Dominion Bridge Company.

APPENDICES:

- 129—Brief submitted by the Canadian Construction Association
- 130—Brief submitted by the Canadian Institute of Steel Construction
- 131—Brief submitted by the Canadian Trucking Associations, Inc.

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Belisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee.

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to engage the services of such counsel, staff and technical advisers as may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinneer, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,
The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, June 11th, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 11.00 a.m.

Present: The Honourable Senators Cameron (*Vice Chairman*), Carter, Haig, Lamontagne, Robichaud and Yuzyk—6.

Present but not of the Committee Senator Isnor—1.

In attendance: Philip Pocock, Director of Research (*Physical Science*)

The following witnesses were heard:

CANADIAN CONSTRUCTION ASSOCIATION

Mr. Mark Stein, President,
Mr. J. Cochran, Director,
Mr. S. D. C. Chutter, General Manager.

CANADIAN INSTITUTE OF STEEL CONSTRUCTION

Mr. R. G. Johnson, President,
Mr. David H. Kennedy, Chairman,
Engineering and Research Committee,
Mr. Ross E. Chamberlain,
Assistant to the Vice-President, Engineering,
Dominion Bridge Company.

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

- No. 129—Brief submitted by the Canadian Construction Association.
- No. 130—Brief submitted by the Canadian Institute of Steel.
- No. 131—Brief submitted by the Canadian Trucking Associations, Inc.

At 12.35 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Chamberlain, R. E.: Assistant to the Vice-President, Engineering, Dominion Bridge Company, Limited, Montreal. Born Toronto, Ontario, July 29, 1929. B.Eng. Civil, McGill University 1951; Ph.D. (Structural) University of Birmingham, England 1953—Athlone Fellow. Diploma in Management and Business Administration, McGill University 1963. Employed by Dominion Bridge Company Limited since 1953 working in various engineering, contracting, and administrative positions. Involved in various major Company projects. Member Canadian Standards Association Committee on Structural Steels, Committee on Highway Bridges, and Sectional Committee on Welding. Member of the Board of Examiners, Corporation of Engineers of Quebec. Chairman of Montreal Branch, Engineering Institute of Canada.

Chutter, S. D. C.: Bachelor of Commerce (UBC) Master of Business Administration (U. of T.). Member, Associate Committee, National Building Code.

Cochran, J.: President, Domtar Construction Materials Ltd., Montreal. Member, Building Research Advisory Committee, (NRC-DBR). Member, Advisory Committee on Modular Co-ordination, BEAM Program (DOI). Director, National House Builders Association and Past Chairman, NHBA Manufacturers Council.

Johnson, R. G.: President, Canadian Institute of Steel Construction, Toronto. Born Calgary, Alberta in 1913. B.A.—1933, LL.B.—1935—University of Alberta. Admitted to Alberta Bar—1936. Estates and Trusts Officer, Toronto and London—London and Western Trust Company—1937-1940. Solicitor, Contracts Officer, Director of Construction Department of Munitions and Supply—1940-1944. Secretary, Department of Reconstruction and Supply—1944-1945. General Manager, Canadian Construction Association—1945-1950. President, Defence Construction Limited, Ottawa—1950-1963. Chairman, Canadian Steel Industries Construction Council. Member, National Council, Canadian Construction Association. Member, Advisory Committee to the Division of Building Research, National Research Council.

Kennedy, D. H.: Manager—Development Engineering, Dominion Bridge Company Limited, Montreal. Born in Ottawa, Ontario in 1930. B.Eng., M.Eng., Ing., P.Eng., M.E.I.C. Received Bachelor of Engineering (Civil) from McGill in 1952; Master of Engineering from McGill in 1953; Diploma in Business Administration from McGill in 1961; Attended Banff School of Advanced Management in 1965. Employed by Dominion Bridge Company Limited since 1953 in a variety of design and construction positions, at present as Manager of Development Engineering. Member since 1964 and Chairman since 1965 of the Engineering and Research Committee of the Canadian Institute of Steel Construction. Member of Town Council (Town Planning Portfolio) of Baie d'Urfé, Quebec. Memberships: Corporation of Engineers of Quebec, Association of Professional Engineers of Ontario, Engineering Institute of Canada, Canadian Standards Association.

Stein, Mark, Eng.: Bachelor of Engineering (Civil), McGill University. Engaged on construction projects in Quebec, Newfoundland and Maritimes.

President of Magil Construction Ltd., Montreal, 1968; Past-President, Montreal Construction Association. Member, Engineering Institute of Canada and Corporation of Engineers of Quebec. Governor, Jewish General Hospital, Montreal General Hospital and YM-YWHA, Montreal.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, June 11, 1969

The Special Senate Committee on Science Policy met this day at 11.00 a.m.

Senator Donald Cameron (Vice-Chairman) in the Chair.

The Vice-Chairman: Honourable senators, we will get under way. You have the list of witnesses who will appear before you today.

It is suggested we start with the Canadian Construction Association, headed by Mr. Stein, the president. Have you any of the officers of your association with you?

Mr. Mark Stein, President, Canadian Construction Association: Yes, Mr. Cochran, Mr. Chutter, Mr. Morgan, Mr. Wallis and Mr. Mahoney.

From the Canadian Institute of Steel Construction we have Mr. Johnson. Mr. Johnson, have you some other officers with you?

Mr. R. G. Johnson, President, Canadian Institute of Steel Construction: Mr. Savage is not able to be here. David H. Kennedy, Chairman, Engineering and Research Committee, is here, and Mr. Ross E. Chamberlain.

The Vice-Chairman: The briefs have been submitted to the members, and I am sure that most members have read them. It is customary, Mr. Stein, for the spokesman for the particular group, to make a brief summary statement. We will call upon you to do that now.

May I just comment, by way of introduction, that I have read your brief and it seems to me to contain a number of very practical suggestions, and we would be glad to hear what you have to say by way of elaboration.

Senator Giguère: Mr. Chairman, may I ask Mr. Stein if he has always been with the M.C.A., Montreal Construction Association?

Mr. Stein: My firm is a member and I am a past-president of the Montreal Construction Association, but I am not here in that capacity today.

The Vice-Chairman: Mr. Stein is the President of the Canadian Construction Association.

Mr. Stein: Mr. Chairman and honourable senators, the Canadian Construction Association is a national body with membership of over 2,700 member firms and over 100 member associations representing general building contractors, road builders and heavy construction firms, specialty trade contractors and manufacturers and suppliers of construction materials and equipment. The construction industry is Canada's largest, with an estimated volume this year of \$13.3 billion.

As mentioned, the CCA represents both the contracting and supply aspects of the industry. I am president of Magil Construction Ltd., a general building construction firm located in Montreal. With me is one of our directors, Mr. Jack Cochran of Montreal, and selected staff members. Mr. Cochran is president of Domtar Construction Materials Ltd., a company with a comprehensive line of construction materials and one which operates its own research laboratories. Mr. Cochran is also a director of the National House Builders Association, which has endorsed in principle the recommendations contained in the CCA brief.

The Canadian Institute of Steel Construction brief supports the CCA submission on matters relating to the construction industry as a whole and it was our thought that it would be convenient for you if we appeared before you jointly inasmuch as some of the questions which you may care to ask concerning our submissions could possibly be applicable to either group.

With your permission, Mr. Chairman, I will make a very brief statement in regard to the CCA submission and Mr. Johnson will follow with an opening statement on behalf of the CISC.

The Canadian Construction Association is very pleased to have this opportunity to present its views and recommendations to the

Special Senate Committee on Science Policy. Members of the construction industry are particularly interested in the work of the committee and look forward to hearing the results of its deliberations.

We believe that any assessment of research and development in the construction industry must be accompanied by an awareness of the unique structure of the industry. We have attempted to outline this uniqueness in our submission.

The construction industry has long felt that finances for a large part of its research and development needs could most properly be supplied by the industry itself through an Industry Development Fund, uniformly assessed on all construction through the support of legislation to this end. We emphasize this in our submission and point out that this would make the industry more self-reliant and reduce requests to the government for assistance. We have directed attention to the need of the industry for operations research of a general nature to supplement the activities of individual firms or specialist associations mainly concerned with specific products or trades. We have also indicated the need for research in the human sciences and have noted the efforts made by the CCA in this direction through such projects as the Canadian Inquiry on Construction Labour Relations.

Our brief describes the size and nature of the construction industry and its principal research areas and then comments on the various activities of federal government agencies in either executing or encouraging construction industry research. This is followed by an outline of research work being carried out within the industry and a description of the proposed Construction Industry Development Fund. The main conclusion and a list of a dozen specific recommendations are contained in the summary and we will be very pleased to endeavour to answer any questions concerning our submission or related subjects that members of the committee may wish to ask.

Is it your wish, Mr. Chairman, that I read the summary and the main recommendations which are to be found on the first two pages of the brief?

The Vice-Chairman: What is the pleasure of the committee? I presume the members of the committee have read the summary. Do you wish to have it read?

Senator Haig: I do not think so, Mr. Chairman. We will be discussing this, and it will form part of our printed proceedings in any event.

The Vice-Chairman: Yes.

Mr. Stein: Mr. Chairman, may I then pass on to Mr. Johnson?

The Vice-Chairman: In view of the fact these briefs are complementary, I think it is desirable we have Mr. Johnson's statement right now.

Mr. Johnson: Thank you, Mr. Chairman.

Senator Bourget: Before we proceed, is there great similarity between the two briefs?

The Vice-Chairman: Yes.

Senator Bourget: Because I did not read it.

Mr. Johnson: In their general tone, yes. There are perhaps some details that will be different. Our brief, of course, relates particularly to our industry, the steel fabricating industry.

Senator Bourget: Thank you.

The Vice-Chairman: Some of the basic principles, Senator Bourget, are very interesting and complementary.

Mr. Johnson: Our Institute is the national trade association representing the structural steel, steel joist and plate fabricating industries in Canada. These industries employ more than 15,000 persons and have an annual sales volume of approximately \$500 million. Our brief is primarily related to activities of our Institute and its member companies. It also contains some views on national science policy proposals. The CISC is a member of the Canadian Construction Association and we support that association's brief in matters relating to the construction industry as a whole.

Our institute was formed in 1930 and granted a federal charter in 1942. Our by-laws provide that our first objective shall be directed towards

promoting greater efficiency, safety, uniform practices and economy in the use of structural steel through engineering and technical research and development directed towards new uses and improvements in design, methods, specifications, standards and codes.

We therefore devote a large part of our effort to this objective.

Environment of the Industry

The environment in which the steel fabricating industry operates substantially reduces its ability to participate in scientific and engineering development. Most of the industry's output is custom fabrication designed by consulting engineers, architects or owners' staff; thus, product design function is separated from the fabricating industry, our product design scope is usually limited to details. Traditional construction bidding practices and bidding documents lead to intense competition based mainly on price and discourage significant product design innovations by fabricators. Patented or proprietary systems are discouraged. The cyclical nature of the industry limits the industry's ability to assure the provision of research funds on a continuing basis.

CISC Research Activity

We support a \$40,000 annual university research grants program jointly with the Canadian Steel Industries Construction Council. The council also supports the Steel Industry Fellow at the National Research Council Fire Research Station. CISC staff and member company representatives serve on many national technical bodies, including the National Building Code committees, Canadian Standards Association committees and a great variety of other organizations concerned with technical and engineering development. CISC's staff of 12 professional engineers, our publications and library service, play a major role in providing the latest technical information on developments in steel.

Major Recommendations

1. "Users" of research (industry, consultants, other professionals) should have equal representation with academics on NRC University Research Grant Selection committees.

2. There should be a less fragmented effort on minor programs and projects and more weight given to economic and social goals in selection of research projects; thus, universities could agree among themselves to choose different research subjects for their own specialization and funds beyond a level devoted to such programs could be used to encourage rationalization and specialization in priority areas of economic or social importance.

3. Eligibility rules for IRAP (NRC), PAIT and IRDIA (Department of Industry, Trade and Commerce) grants should be made more flexible to meet the development priorities of different industries. Present rules favour laboratory research and proprietary product development. They appear to exclude much applied work on manufacturing techniques and productivity improvement.

4. The IRDIA tax incentive should be 25% of all eligible expenditures rather than 25% of the increase over the previous five-year average.

5. The PAIT repayment requirement be revised in order to reward success as well as subsidizing the risk of failure.

National Science Policy for Canada

We accept the concept of a National Science Policy co-ordinating federal programs with national goals, and the concept of major mission-oriented programs directed towards these goals.

We believe there should be more emphasis on "development" in Canada (relative to basic research) and that a higher proportion of work should be done by industry.

In establishing research priorities it should be recognized that economic growth provides the tax base which supports social measures.

International exchange of technology is essential. In many fields there is more economic value in applying the best foreign work to our situation than in doing original work of limited application.

My colleagues will be pleased to answer questions. Mr. Kennedy, on my right, is Chairman of our Engineering and Research Committee and the major author of our brief. Dr. Ross Chamberlain is a member of the Canadian Standards Association's Associate Committee on Structural Steels and other important technical committees.

The Vice-Chairman: Thank you. Now, the leading inquisitors, this morning, are Senator Bourget and Senator Giguère. I do not see Senator Yuzyk here.

Senator Bourget, are you ready to lead off.

Senator Bourget: As I explained, previously, Mr. Chairman, I was told the steel industry was not to be here. I confined myself to the Canadian Trucking Associations. I thought that having reviewed that brief I would have enough questions for an hour, but

unfortunately I did not have time to read the other briefs.

I may start by asking a question; what kind of organization do you have in research as far as the construction association is concerned, and maybe also the steel industry? Have you got laboratories? Have you got a big staff and how much is your budget for research in each of the associations that you represent?

Mr. Stein: On behalf of the Canadian Construction Association, we have no laboratories. I think I must refer to my opening remarks of the unique nature of the industry and the unique nature correspondingly of the Canadian Construction Association. We represent contractors; that is, general contractors, trade contractors and the heavy construction contractors. We also represent manufacturers and suppliers so that within our own association we have competing interests. For example, structural steel vs. cement products vs. timber products. Within the body of the association there are research and laboratory facilities maintained, usually, by individual companies on their own particular products.

So, as such, the CCA does not have laboratories, but we do have one giant laboratory in all of Canada and this is where we call on the social and the life sciences. We have just conducted a major inquiry in construction labour relations. It is right across Canada. This is a giant laboratory and affects everybody.

Senator Bourget: But, in the case of material, for instance, how much of the material used in construction, either in steel or roads or buildings, is supplied by U.S. firms compared to Canada's firms.

Mr. Stein: I will ask Mr. Cochran and Mr. Johnson to bear me out, but I would say that other than certain manufactured specialties, the bulk of it is manufactured in Canada.

Senator Bourget: In Canada, and those industries who are manufacturing those materials, some of them are big ones, I suppose and then have their own research laboratories, is that true?

Mr. Stein: Could I ask Mr. Cochran and Mr. Johnson to supplement my remarks?

Mr. J. Cochran (Director, Canadian Construction Association): One of the factors we must bear in mind in looking at construction materials basically is that they tend to be

heavy in weight. Transportation costs are very high in relation to selling the products. As a result the products, generally, must be manufactured in the general area in which they are consumed. It is for this reason, I believe I can confirm the comment of Mr. Stein, that the majority of products consumed by the construction industry are manufactured within Canada.

As far as the research work of the various companies is concerned, you will appreciate that some of the major suppliers of the construction industry are subsidiaries of American companies. Those companies probably do not devote as high a percentage of their sales to research in Canada as Canadian-based organizations.

Senator Bourget: In steel, for instance, Mr. Johnson, the research would be made particularly in the United States, but what about large companies like Algoma Steel?

Mr. Johnson: The situation in Canada is that Canadian mills do have their own research laboratories and they have continually expanded these, particularly in recent years. The achievements of the Canadian mills in the field of developing new, high strength steels are a matter of international record as being extremely good.

They have also expanded the production of Canadian steels very substantially in the last five to ten years to the point where, to a large degree, the Canadian Construction Industry is able to obtain its requirements in Canada. There may be occasions when this is not so for specialties, or there may be occasions of very, very high demand when this may not be so, but under most conditions the industry is virtually self-supporting from Canadian sources. It has been a considerable achievement for the industry.

As a result, in part, of this research development, so far as the Canadian Institute of Steel Construction itself is concerned, we do not have our own laboratories. We do use the research facilities of the universities for research grant programs and, as I mentioned, we do have established at the Division of Building Research, National Research Council, a Fellow who the industry supports. We carry out these activities in co-operation with another steel organization known as the Canadian Steel Industries Construction Council, which is very largely supported by the mills, but the CISC is a fabricator organization basically, although it is assisted and supported by the mills as associate members.

Senator Giguère: Mr. Stein, are the grants of the CMHC, in your opinion, sufficient? I am thinking of low cost house building. Is there sufficient research being done by CMHC or the Division of Building Research of the NRC?

Mr. Stein: The Division of Building Research of NRC is a very valuable arm of the government and very important to the construction industry. In our brief we deplore the fact that their finances have been restricted so that their activities have been cut down.

With respect to housing, I would ask Mr. Cochran, who is a director of the National House Builders Association, to answer that question, sir.

Mr. Cochran: I think I would have to say the lack of grants from CMHC has retarded the capability of the industry in meeting the social needs of low cost housing. The industry does have the capability but because of its fragmented nature, some assistance is required.

Senator Bourget: They are not the only ones doing research in housing. There is also some research done in universities, I understand, is that right?

Mr. Cochran: As I understand it, sir, there is in the area of the social approach in housing, but, not as far as the meeting of economic problems is concerned. That is my understanding.

Senator Bourget: I thought that some grants had been given by the government either through NRC or some other organization to the universities for research in building also.

Mr. Cochran: I stand to be corrected, I am not aware of the same.

Senator Bourget: I think so. Mr. Chairman, do you remember that?

The Vice-Chairman: I do not. The statement has been made that in the past 14 years Central Mortgage and Housing has only spent \$2.7 million on research on housing, is this correct?

Mr. Stein: I would not know those figures, sir, but I do know that the National Research Council's Division of Building Research is the research arm for Central Mortgage and Housing Corporation. Perhaps I could ask Mr. Chutter to comment on that.

Mr. S. D. C. Chutter, General Manager, Canadian Construction Association: That is true. As I understand it, CMHC refers their technical enquiries of a building nature to NRC. In addition to that they do have, under the National Housing Act, authority to make grants for research in various aspects of urban development and housing specifically. I think, so far as the industry is concerned, in the past these have been illustrated mainly by grants from CMHC with respect to a series of experimental low cost houses. They are up to Mark VI now. This is a project carried out jointly by CMHC and the National House Builders' Association, with assistance from the NRC Division of Building Research. Usually, they are built by builders. There are a couple here in the Ottawa area, built in the past.

One other aspect is referred to in paragraphs 36 and 37 of our brief whereby under the National Housing Act it is possible for the CMHC to make grants to manufacturers for research in the field of product development. Now, as is mentioned in the brief, the nature of the grants makes them much more attractive than those which are available under the much better known PAIT and IRDIA programs. To our knowledge, however, relatively little use has been made of these research grants. One was recently made, for example, to the Crane Company. I think it was roughly \$79,000.00 for research in the development of bathroom designs and materials.

We think that this provision in the National Housing Act might be expanded and some of the limitations removed, but more particularly perhaps more publicity given to the availability of these grants. The grants have been on a relatively small scale in the past insofar as CMHC grants available to industry, either firms or associations, are concerned.

Mr. Stein: I wonder if I might say a word, Mr. Chairman?

I would like to stress, gentlemen, the proportions of construction volume. Housing is a very important part of the economy and certainly, as far as the Canadian public is concerned, this is their first thought when discussing construction, but housing construction represents 30 per cent of the total volume of construction in Canada.

The Vice-Chairman: Socially it is very important.

Senator Carter: You mean residential?

Mr. Stein: Yes, residential construction accounts for 30 per cent of the total volume in Canada. We are also talking in terms of the other 70 per cent without which housing would be impossible. I am thinking of the roads and the highways and the bridges and the hydro-electric developments and the industrial plants and office buildings, schools and churches and hospitals. Without all these other forms of construction, housing cannot exist, and, I think maybe it is not presumptuous on my part to ask you to bear in mind that there is an overwhelming preponderance of another type of construction which directly or indirectly has a very great influence on the economy, despite housing's popular appeal.

Senator Bourget: From your own experience would you say there is enough basic research done now in universities or in NRC; I mean basic research?

Mr. Stein: No, sir, not enough.

Senator Bourget: Not enough.

Mr. Stein: I think the construction industry generally, should be proud of its rate of development and the rate of new material introduction. Technological development has, I would say, in the last 25 years, accomplished more than in the previous 250 years, but it is just starting and I think, personally, that there is room for a great deal more.

Senator Bourget: Well, following this, would you then recommend the establishment of research institutes in construction of all kinds or what we call "centres of excellence," where you could develop that kind of basic research you say we may need here in Canada? This has been recommended by many organizations, to create centres of excellence in some parts of Canada. Of course, construction, building roads, will be different in some areas on account of the weather which is different in many parts of Canada, but do you think that we should have two, three or four centres of excellence to do specific basic research on construction?

Mr. Stein: I think, sir, you have to break that down into the two concepts I spoke of earlier; firstly, as an industry-wide research centre and dealing with the problems which affect the entire industry such as education and training, labour relations, business practices, economics and statistics, and technological research and planning. These would be industry-wide in their scope. The other aspects of the actual development of construc-

tion materials becomes a different problem because we are now talking of competing materials. We have supported the Department of Industry, Trade and Commerce's pilot project of a Central Information System where all information on construction materials and products are easily available through a computer memory bank, where all of this information is fed in and retrieval is immediate, and this we feel would be a great help.

Have you anything to add to that, Mr. Cochran?

Mr. Cochran: I would like to add one thing that I think we have to look to in the construction industry and that is it has not been a revolutionary type of development that has been taking place. It has been an evolutionary type. Any manufacturer, looking at the amount of money he can afford to spend on research and product development in Canada, has to have an evaluation of the commercial opportunities of which he will avail himself, if he achieves success in development of this product. The restraint that we have had has been the lack of a uniform national building code.

The Vice-Chairman: Hear, hear.

Mr. Cochran: And this is, in my opinion, one of the detrimental factors we are facing in expecting industry to upgrade or step up its aggressivity in the area of broad development.

Senator Carter: Do you regard, as part of the construction industry, the manufacturers of materials?

Mr. Cochran: We are directly involved. The industry's health and wellbeing dictates our health and well being.

Senator Haig: Uniform standards or by-laws should be adopted through Canada. Why is that not being done?

Senator Bourget: Mr. Chairman, that is a responsibility of the provinces and the municipalities, as I understand it.

Mr. Stein: Senator Bourget has answered the question. They are in the autonomies of the various municipalities. Sometimes it is governed by a provincial department of municipal affairs.

Senator Haig: Why cannot the provinces get together and do that?

Senator Robichaud: You refer to all phases of construction; say for example construction

of a steel roof. In some areas, some sections of Canada, they may require a 30 pound snow load while in others they may require a 70 pound snow load, can it be uniform all across Canada? I mean, if there are different conditions which apply.

Mr. Stein: This is a question of individual design, sir, that can be executed within the concept of the National Building Code. For example, the actual design of a roof structure would not necessarily be the same in British Columbia as in other areas, if the snow load table showed different requirements, based on average snowfalls recorded for the various regions of Canada.

Senator Robichaud: There are certain by-laws that do apply to it, certain building by-laws?

Mr. Stein: It may merely require spacing the joists a little closer in order to carry a heavier load.

Senator Robichaud: All right.

Mr. Stein: Different materials can be used to serve that function. I believe Dr. Chamberlain wanted to expand on these science centres.

Mr. Johnson: If I may just introduce this, I think perhaps Mr. Kennedy would like to say a word on the question of centres of excellence and the contrast between basic research and development research. If I could just interject, since we are talking about the uniform national building code, I think in relation to what the honourable senator said about different conditions in different parts of the country, to a large degree there has been a strong effort on the part of the draftsmen of the National Building Code to draft it in such a way that there is a lot of consideration for local conditions. What the construction industry devoutly hopes for is that there will be virtual adoption across the country. Some progress has been made in this direction by a step the establishment of a committee by the provincial government to study uniform building codes in that province. If that committee recommends and the province accepts the concept of a uniform building code in that province, it may very well be that this will be a stepping stone to similar adoptions in other provinces. I certainly hope that may be the case.

Senator Bourget: Has your association made an approach to different provinces to

try to understand that? I think it is needed now. We should have a uniformity of building codes all over Canada with some differences, as Senator Robichaud has said, because of weather conditions in certain areas. But, have you made approaches to the provinces? I am not a lawyer, but I feel that it is a question that could be settled by the provinces, and I think also you have something to do about it, not only this committee. We could pay great attention to it but I think it is up to your association, which has members from all the provinces, to present this. We have the inter-provincial association, as you know, so you could also present your problem on the national building code to that association.

Mr. Stein: Our affiliates have been promoting this, as well as the National Association and a great many of our local affiliates have also been trying for acceptance of the National Building Code.

The Vice-Chairman: Mr. Kennedy?

Mr. David H. Kennedy, Chairman, Engineering and Research Committee, Canadian Institute of Steel Construction: I would like to comment with respect to the previous question of Senator Bourget and Mr. Stein's reply. I think there is a bit of a trap in the use of the words: "basic research", "applied research", "product development".

Senator Bourget: It may be a combination of the two.

Mr. Kennedy: They have a rather specialized meaning within this committee, I believe. I could say the activities which Mr. Stein was supporting in terms of the vocabulary that is being used generally within the committee follow more within the applied research or more particularly in the development and even in the human sciences field, economics and so on. Not perhaps in basic research as the term has been used most generally in your committee's experience.

Senator Haig: I would ask another question, Mr. Chairman. The brief says:

Priority should be given to a study on the implications of the conversion to the metric system, including a schedule and related requirements for construction operations.

How far has that been implemented?

Mr. Stein: To my knowledge, sir, it has not been.

Senator Carter: Is there any research being done on it?

Senator Hays: I think that is a federal responsibility and there has been a great deal of thought back as far as 1963, that I know of, and I would suppose that the federal government is actively working on it. This problem is a very important one.

Senator Carter: Somebody must be making a cost benefit analysis of this. Is that being done?

Mr. Chutter: I might just mention with regard to Senator Hay's remarks; we understand that within the federal structure the proposed Standards Council of Canada is to be the body which is to do the development with the metrication of measurements in Canada. One cause of some concern has been the delay in the establishment of the proposed Standards Council of Canada. We understand that perhaps legislation may be introduced later this year but there has been over a year passed by since a Dominion-Provincial Conference was held prior to setting up this Council. It has the concurrence of all the provinces. We understand that at the conference several provinces made their supporting views on metrication known very plainly. As you probably know, in Great Britain now there is a conversion over to the metric system. Insofar as the construction industry is concerned, there has been a five-year phasing worked out. We in Canada could benefit from their experience. But, to our knowledge, there has been nothing positive done towards developing this change-over programme in Canada pending the establishment of the Standards Council of Canada.

Senator Bourget: Could you tell us a little more about the experience in the United Kingdom? I think they started five or six years ago. I do not remember exactly.

Mr. Chutter: Not so long ago, senator. I think the construction industry is due to be converted by 1971, so they are about half way through the phasing now and they in turn were able to use the experience of India and other countries. We think it would be perhaps easier to accomplish in our industry, because a lot of the personnel in construction and design offices come from Europe and are familiar with the metric system.

Senator Carter: Can we go ahead before they do in the U.S.A.? Are we not geared to them?

Mr. Stein: Not necessarily, sir. Here is an opportunity for us to get ahead. With 90 per cent of the western world on the metric system and with Canada's export market growing, a great many Canadian manufacturing and engineering firms are now selling all over the world. If we go metric before the United States then we could get the jump on them. There is another very important factor that I would like to bring to your attention, and that is that more and more the construction industry is thinking in terms of modular co-ordination and systems buildings. When you are talking modular then you must have a module. The metric system is very important in this regard and modular co-ordination is another means of improving productivity in the construction industry.

Senator Carter: You think we should be pushing on with this?

Mr. Stein: I most certainly do, sir.

Senator Bourget: How long does it take?

Senator Hays: It takes some bullheaded minister to push it through. That is what they require.

Mr. Stein: A five year programme in the U.K. is it not, Mr. Chutter?

Senator Bourget: Is there much cost involved in introducing this new system?

Mr. Stein: I think, sir, that the manufacturing end of it would be the most costly. In the actual field, or on-site, part of the industry, it only becomes a matter of re-education, a different ruler for the man who is going to use it, but in the manufacturing industry, Mr. Cochran will agree, there can be some rather heavy expenditures involved.

Mr. Cochran: The conversion cost, in switching over to the metric system, can be fairly heavy. One always has to appreciate that you are going to be carrying double inventories for some period of time so the company's working capital has to be increased. In some areas where we are producing products with 48 inch width we must recognize that if we go to the metric system we may be going to supply them on a narrower basis. If we do the cost of that product will increase, not decrease, so we have to literally look at it on a product basis. I do not

think we should get involved in looking at individual products.

Senator Hays: Some great political ramifications.

Mr. Cochran: That is correct.

Mr. Kennedy: Without digressing about the desirability of the principle, ultimately one assumes the whole world will go metric. I think if you get away from the field side, where previously it was stated that the only cost is a new ruler—in practice it is a little more than that!—and as you get into manufacturing where there is the matter of rather expensive capital equipment which is built on the English system of feet and inches; the more you get into manufacturing and even away from our own structural side into the machinery building side, the more caution there is about the costs and perhaps the more concern that we should co-ordinate with the United States.

Senator Bourget: Is there some great opposition then from the manufacturing firms to change our system, to your knowledge?

Mr. Stein: I cannot answer that question, sir, I do not have that knowledge.

Mr. Cochran: I do not have sufficient expertise in this. I can say that the industry certainly supports the concept of modular and "let's get on with it". We have literally said we would prefer to go modular on the current measurement system rather than wait for somebody to prescribe the metric. We believe there are some advantages through modular.

Mr. Kennedy: Without opposing that ultimately the world will be metric, I think on our part the question is: Where is the conversion cost coming from?

Senator Bourget: During the period of transition was there any help in Japan or the U.K., I mean financial help, from the government?

Mr. Chutter: I think that in Canada for any transitional period there should be some financial help, as has been the pattern for industry seriously affected from the cost standpoint in other countries that have gone metric.

The Vice-Chairman: I believe that the United Kingdom Government has estimated it will require a subsidy of £1,500,000 to finance the changeover.

Senator Hays: Would that be in the form of a subsidy?

The Vice-Chairman: Yes, to take up the slack during the change over period.

Senator Hays: You will never know all the problems until you decide to phase it in; then they will come. You do not need to worry about that, but then it is a question of phasing it in properly so people are not going to be hurried and will know what the subsidization program will be.

The Vice-Chairman: Both the Steel Institute and the Construction Association have emphasized the need for more research, particularly at the applied level. I quite agree with that, but should not this matter of the metric system be one of the factors to be included in a national program of research for the industry? Then, in that case, how should this be done? If we are charged with the responsibility of formulating a science policy for Canada we should be able to make some recommendations as to how this should be handled. Senator Bourget asked about the number of centres of excellence where this research might be done, and I think we would need to know something about this: where it can be done, where is the best region, the natural resources, where this can be most effectively handled, and what kind of research should be required, and, finally, how it should be financed. You have made some suggestions in both briefs about the financing. I would like to get into that later but what would you like to see with respect to these centres or institutes?

Senator Bourget: That is a good question.

Mr. Stein: I think, sir, we would like to see, first of all, the actual formation of a Standards Council of Canada, as we recommended, as the overall central body.

Senator Bourget: Would that be your first recommendation?

Mr. Stein: I think so.

Mr. Chutter: With respect to the metric system.

Mr. Stein: With respect to the metric system.

The Vice-Chairman: This would be a part of the total program for the construction industry. That is only one part of it. What about the rest of it—research and materials, modular design, and so on?

Senator Bourget: Construction methods and all this?

Mr. Stein: We feel that the Division of Building Research of the National Research Council would be a very appropriate body along these lines also.

Mr. Chutter: I might add, gentlemen, the Division of Building Research does have regional research stations in several parts of the country because of the nature of the industry. It has, for I guess a couple of decades or more now, been deemed reasonable and desirable for certain types of research activity to be carried out as NRC functions and I think the industry, generally speaking, has been very well pleased with the program of the Division of Building Research. Our own association has recommended now, for some little time, that the freeze to which DBR has been subjected as part of the overall policy for government establishments be relieved, because of the high priority for certain types of building research which are best carried out by objective, quasi-public bodies. But, as we understand it, DBR is still subjected to these curtailments and this has meant that the research programme has been retarded and a number of things which have been requested by the industry have been shelved pending further funds or further staff.

The Vice-Chairman: Are you saying that in your opinion, the opinion of these two associations, the National Research Council and its regional establishments satisfactorily meet the need for all research in the building industry?

Mr. Stein: I was thinking, Senator Cameron, of the type of technical research which is appropriate, let's say, for a government agency. Now, as far as research being carried out by the industry is concerned, the briefs both recommend certain changes be made in the type of encouragement or incentive available either to individual companies or to sectors of the industry which may maintain their own research facilities. Now, when you get down to the products or the product type of research you are getting into a highly competitive area which is best carried out by the parts of the industry or the firms concerned. I wonder if that distinction can be made? They provide, I guess, the sum total of the main type of laboratory or organized research and I think generally speaking it is felt that both sides should be increased.

Senator Bourget: But a central body would co-ordinate all the research that you need not only in building construction but in road construction and in the other spheres of activity you mentioned a few minutes ago. Who would be the central body that would co-ordinate? Would your association recommend some priorities or would it be left to some government agencies or science council or some other organization you may have in mind? We need co-ordination. It seems to us, from what we have heard so far, and I am only repeating what has been said often in this committee, that there is duplication of work. So we need a kind of central organization to co-ordinate that. What would you suggest as a co-ordinating body?

Mr. Chutter: I wonder if I might comment? I am afraid this is probably out of our field of expertise.

Senator Bourget: But you understand the importance of that?

Mr. Chutter: Yes, I do. One of the problems, I think, gentlemen, has been the vastness of the construction industry. I think that within various sections of the industry there is probably a pretty fair co-ordination. You mentioned, Senator Bourget, the need for co-ordinating the results of research activities in, say, the road building field. In that respect such organizations as the Provincial Highways Departments, the universities and so forth, have maintained a fair volume of research supplemented by the special research programmes of associations such as the Technical Asphalt Association and so forth. The Canadian Good Roads Association acts, as a sort of co-ordinating body insofar as flow of information is concerned. You then have the housing research area. You have the research in systems and what might be part of the BEAM Program and so forth. The Division of Building Research, as a standard rule, does not initiate any new research project until it has surveyed the field to see if anybody else has ever done any work in it to avoid duplication. One of its main functions, actually, is to be a repository of the results of research activities not only in Canada but also around the world. It is hoped that the Construction Information Centres, which have been proposed under the BEAM Program, will give another bank of technical knowledge which would be available to interested people to look into in various centres across the country. But there is a differ-

ence between centres of information where you can get data or see displays on the one hand and actual applied research or even pure research activities in a laboratory on the other.

To co-ordinate all that would be quite a function but within the various main areas I think there is at least a fair degree of co-ordination. It is not perfect by any means, but in the specialized areas there is some knowledge as to what various people are doing as long as it does not get into the competitive area. Then this becomes a business secret.

The Vice-Chairman: I believe Mr. Chamberlain wants to interject here.

Mr. Ross E. Chamberlain, Canadian Institute of Steel Construction: I have just one comment which may perhaps be more closely related to the products handled by the members of the Canadian Institute of Steel Construction. I think it is important in this type of discussion about research and research facilities and centres of excellence, and so on. Remember, there are really two facets here; one is really the product and product performance, and the other is the process to make the product, and manufacturing economy. I believe the contribution by the Division of Building Research, the Department of Energy, Mines and Resources as well as others, has been excellent. In some areas they have produced very handy work with respect to, say, welding technology and things of this type that affect the production of these products. But there are many facets of product-oriented research which have to be handled by industry because the capital investment of a plant, let us say, is such that you cannot afford some pilot processes of a research nature. You have to try them right on the shop floor. I think it is important to segregate in your minds the product facet and the production facet.

Mr. Kennedy: Could I elaborate on what has been said? I think the question was: who should co-ordinate everything in the construction field? Perhaps it is not possible. There is a spectrum, and I said before that the spectrum was basic research, applied research, development, product development, a commercial face lift to make the 1968 model the 1969 model, all these product oriented—let us say there is the whole manufacturing side, the efficiency of production side, the efficiency of field labour side, which Mr. Stein has touched on which are not product oriented or

method oriented. There is finally the type of economic research which, if I could call it that, has been touched on in the CCA. brief which is again another part of the spectrum. At the present time the Division of Building Research, which is incidentally, in my opinion, one of the most applied of the twelve divisions of the National Research Council, is still, from where we look at the problem, rather towards the basic end of things. As you move through this basic, applied development area you come into areas which, for commercial reasons, are perhaps more appropriately carried by industry and that is really the essence of recommendations 3, 4, 5 in the summary which we have presented.

It is that the present government programs, be they NRC or Department of Industry, are oriented rather strongly to the product side, first of all. The NRC in-house programs tend to be fairly basic or basic and applied end of the spectrum. The NRC money, which is made available to industry through the IRAP program is more or less in the applied sphere still related to product. The Department of Industry has attempted to move in at the development end of the spectrum with certain programs for which, for reasons elaborated on in the two briefs, have not been well taken up in the construction industry. As you get down into the very commercial end of things, or the economic end, touched on in the CCA brief, I don't think there is anybody who is doing the co-ordination at the federal government level at the present time. I could be mistaken.

So, summing up this rather rambling reply, the body now existing which would seem to be able to provide a co-ordinating function at the relatively basic and applied end is the Division of Building Research. Some of their advisory committees could be collaborated with to provide a broader co-ordination of both their in-house programs and supportive research and development in industry. At the development end, at the present time, it is the Department of Industry. Whether it is possible for one body to co-ordinate all this wide spectrum is not for us to say.

Senator Bourget: It would be very difficult.

Mr. Kennedy: The force of our brief, I think, is that naturally everybody would like more money for everything. I guess that is the story of government, but in terms of where the resources are now going our feeling is, in terms of the balance, there should be more at the development end and this

could essentially be achieved by a broadening of the support available to industry either in terms of individual companies or in terms of this industrial development fund referred to in the CCA brief, whichever may be appropriate to the case.

Senator Robichaud: Mr. Chairman, in connection with this construction industry development fund, which is recommended in the CCA brief, when it says this fund:—

...would enable the Industry to expedite needed research and development work of a general nature and make the Industry less dependent on the Federal Treasury.

Now, could we have comments on this? What I mean to say is how large a fund does the association have in mind and what percentage should be dependent upon the Federal Treasury? I know it is an interesting factor in the summary which stated here:

The construction industry is Canada's largest, with an estimated volume this year of \$13.3 billion.

This is larger than the total budget of the Federal Government.

Senator Carter: I would like to join my question to that. What I want to know is how much of that 13 billion will be profit and of that how much are you putting into research as an industry?

Mr. Stein: I think, sir, you have to come back to the nature of the industry and its association. In the first place there are no restrictions on anybody coming into the industry. Let me talk as a contractor. For example, a doctor, a lawyer, a chartered accountant or any of the recognized professions have their associations with certain disciplinary and regulatory powers. There is no such body in the construction industry. Other than two Corporations in the Province of Quebec, that is the Corporation of Master Pipe Mechanics and the Corporation of Master Electricians, membership in all associations is purely voluntary.

Senator Carter: Surely, as an industry, one of the major industries in the country, you must realize that as an industry it is to your own benefit to be doing research and not be depending so much on the federal government or the NRC.

Mr. Stein: We are saying, sir, that with the enabling legislation for an industrial develop-

ment fund the industry could very well carry out certain programs. A sample in a very, very important field is that of labour relations. This has been a growing problem and I am sure you have all read of strikes that are currently in progress in Canada.

Senator Bourget: Right now?

Mr. Stein: Right now. We are talking of an industry which employs directly on site some six hundred thousand people. We are talking in terms, on labour's side, of competing unions. We engaged in this Canadian Inquiry on Construction Labour Relations as a research project and it was all financed by voluntary contributions. We have produced a full report and twenty specific recommendations but this is just a start but because there is no enabling legislation to make everybody in the industry contribute towards these programs we have difficulty meeting our \$120 thousand cost.

Senator Bourget: What is your annual budget?

Senator Robichaud: This is very interesting. Take the fishing industry, for example, they have a Fisheries Council of Canada, also on a voluntary basis. Last year they wanted to undertake a survey of the domestic consumption of fish in Canada. They didn't have too much problem to assess the industry for, say, \$50 thousand. They contributed their share of \$50 thousand, the federal government contributed \$100 thousand and the provinces another \$50 thousand. So they contributed their share of the survey, and participated in the survey; in fact it was undertaken by them. They accepted grants from the federal and provincial governments on the basis of the value of fisheries in each province. It seems to me that the construction industry, with such a huge volume of \$13 billion against a few hundred million for the fishing industry, could organize better than they are and contribute as a whole to such a project.

Mr. Stein: The fishing industry, sir, is one in which you are dealing with one product, fish. When you are talking about the construction industry I think the two main characteristics are its mobility and variety. Now, if you think of just the variety in the construction industry, we talked about residential construction. It can take various forms from the individual home to a high-rise apartment building and these two are not necessarily the same thing. A hydro-electric development is a far cry from an office build-

ing. So you need different equipment, different skills. You are talking of a variety of products. You are talking about a variety of skills within the industry itself. We have a proliferation of specialties in the industry, all of which are necessary and all of which have contributed to productivity in the industry because, by specialization, you gain economy. But, by its very nature, this is both our strength and our weakness. You have a variety in the size of a contractor. There are but few contractors that do as much as 1 per cent of the total construction volume and you will have a variety of practitioners in the industry from the single artisan who takes on a contract to do a little bit of work to the giant of the industry with a completely integrated staff of management, technical, professional, supervisory and actual trade skills on the site. Then there is a full gammit of thousands and thousands of specialty firms. To co-ordinate all these, to bring all these people into the fold on a voluntary basis, is our greatest difficulty.

Senator Robichaud: This is the main reason why you are asking for legislation, then?

Mr. Stein: That is correct.

Senator Robichaud: You would like to have legislation.

Mr. Stein: Enabling legislation for the industry.

Senator Carter: Any industry or the whole construction industry?

Mr. Stein: We, sir, are speaking for the construction industry as a whole at the moment. This need has been recognized elsewhere. In South Africa, for example, there is an industrial development fund. In France there is an industrial development fund which is attached to the national vacation pay plan. There are industrial development funds in many of the western European countries.

Senator Carter: You mean you could not have it without an act saying you have got to have it?

Mr. Stein: You could not, sir, as long as there is voluntary participation. It means that the load is carried by the few, dedicated people who are concerned with the welfare of the industry.

The Vice-Chairman: Have you ever applied for legislation?

Mr. Stein: We have suggested to Mr. Trudeau and the cabinet that there are several areas in which an industrial development fund could be financed. One of them would be the employers' overpayments on the Canada Pension Plan. These overpayments are substantial amounts.

The Vice-Chairman: But you are dealing now with financing. First of all, you have got to have legislation. Who are going to be the members of it, whether they join voluntarily?

Mr. Stein: Yes, in the province of Quebec there is a bill due to come up for the licensing of contractors. Now, this would be a form of enabling legislation although at the moment it does not foresee any contribution to an industrial development fund as such. We are thinking in terms of an industrial development fund that is national in nature.

Senator Bourget: Because of mobility?

Mr. Stein: Correct.

The Vice-Chairman: But to be practical on the matter, are you as an association prepared to suggest to the federal Government a draft bill, which might be dealt with shortly, spelling out the terms of membership and its purposes which would include the research fund, the detailing of how you raise the money. You have dealt with this in various ways and this can be done, you have got to have the bill first and you have got to have the membership who will be affected by that bill spelled out.

Senator Carter: What are your major problems? Let us assume you have a fund now, somehow or other you have got it. What problem would you start tackling in research?

Mr. Stein: I would continue with the first one, which is labour relations. In order to arrive at a rational, logical means of conducting our labour-management relations within the industry. This is a subject in itself and we could speak for hours on that, sir.

Another very important item is education and training. This involves the whole gammit from the training of apprentices to retraining and reorientation in view of technological developments. It means the training and education of people at the technicians' level, the supervisory level and the management level, and we have just barely made a start on that. This is important. Business practices are very important, too, and economics and statistics. There has been a lack of sufficient statistics.

The Dominion Bureau of Statistics does a good job in this field, but some series are two or three years behind and by the time we have the figures they are obsolete. With the finances the industry could carry out programmes of economic and statistical studies. Forecasting more accurately than we can now and the other subjects tie in because if you can forecast what your demands are going to be then you are in a better position to embark on a suitable program of training the personnel to meet those demands.

Senator Carter: You would not set up a research laboratory anywhere or you would not contract out research projects to universities?

Mr. Stein: If it were a research project which affected the industry as a whole.

Senator Carter: You have got none of them, you have not mentioned any of them.

Senator Robichaud: Labour relations must be one.

Mr. Stein: Yes, we have just scratched the surface on that. There is a tremendous amount of work to be done.

Senator Carter: I would like to challenge one word you said about the Dominion Bureau of Statistics. I am not a champion of the DBS. I got their book this morning and it gives the figures right up to 1969.

Senator Bourget: On what?

Senator Carter: On Construction in Canada.

Mr. Stein: This is the first year that this has come through so early.

Mr. Chutter: Those are one-year forecast estimates, senator.

Senator Carter: These are not estimates for 1967 and 1968.

Mr. Chutter: You will have the final figures for 1967, the preliminary figures for 1968 and the projected figures for 1969.

Senator Carter: This goes back to 1960. One question I wanted to ask about this is why has inflation struck the construction industry so badly? Apparently it has struck this industry much worse than most industries, because in 1960 the cost in dollars of construction was a total of \$6.8 billion or \$6.9 billion and the projected figure for 1969 is nearly double, 100 per cent.

The Vice-Chairman: But when you come back to the cost in dollars you are only up from \$6.5 billion to \$8.5 billion; you have only gone up about 30 per cent as against almost 100 per cent in current dollars. Most of that has happened since 1966 and I am just wondering if we could find out why that is.

Mr. Stein: We have, sir, and this is a large subject. There are a great many reasons. I think one of the prime reasons is the cyclical nature of the industry and what cannot be overlooked is the contribution of government to the swings from high volumes to low volumes.

Senator Carter: Yes, you just told us the Government does not interfere too much except in the housing and residential which is only 30 per cent you told us. There is another 70 per cent.

Mr. Stein: On the contrary, sir, the imposition of an 11 per cent and 12 per cent federal sales tax on construction materials has been a very important factor in costs. Even in a seemingly small amount, the 2 per cent Canada Pension Plan assessment is a cost on construction. 1.8 per cent means about 1 per cent of the total construction cost. Some of the fiscal and the monetary policies have had a great effect on the construction volume and on construction costs. Also the direct expenditures by government at all levels in construction across Canada is responsible for about 40 per cent of the total construction volume.

Senator Carter: Did you say what government?

Mr. Stein: Governments at all levels, federal, provincial and municipal, are responsible as purchasers of 40 per cent of the construction volume by and large.

Senator Carter: 40 per cent?

Mr. Stein: Of the total construction volume.

Senator Carter: \$13. billion, this is 40 per cent of that is going to government?

Mr. Stein: If it follows the same pattern as it has in the past it would run approximately 40 per cent. It has been a subject of many of our briefs to both federal and provincial governments to plan ahead and to establish a more even growth-rate and to get away from the practice in the past of governments throwing their direct projects on the market when the private sector was busy and withdrawing their projects when the private sector slows down a little bit.

Senator Kinnear: Mr. Chairman, I would like to know what the labour costs' rise, in the last five years, is in the industry.

Mr. Stein: The labour costs have been higher than they should be. We are the first to admit this and we are certainly concerned with it.

Senator Kinnear: That is not the type of answer I wanted. I would like to elaborate. We are all suffering from that.

Mr. Stein: Yes, we are suffering from it because of the needs of which were emphasized in the Goldenberg-Crispo Report. I think probably one of the basics is the fact in almost all provinces in Canada, except one, the provincial labour relations statutes are antiquated. They do not take into consideration the special needs of the construction industry.

Senator Kinnear: You must have an idea of the increase in labour costs.

Mr. Kennedy: We could give some specific rates, the carpenters' rate.

Mr. Stein: I think last year the average rate of increase was 11 per cent. Last year was not a major negotiating year. This year is. We have here, now, some demands that have gone as high as 54 per cent.

Senator Haig: 54 per cent increase?

Mr. Stein: Yes, one trade for one year. Now, I think you have to look into the reasons. We have just returned from a tour of the west which started in Winnipeg. It took us up to Whitehorse and ended in Victoria. As long as you have individual trade union locals negotiating and signing agreements with individual contractors we will never arrive at a rational means of labour-management relations. We heard a story in Vancouver of a major job, Brenda Mines, to be exact, where the job was closed down because the plumbers were on strike and that strike lasted for five weeks and that was settled at an increase of \$1.85 an hour over a basic rate of \$4.00, approximately.

Senator Bourget: For how many years, two years?

Mr. Stein: A one year agreement.

Senator Bourget: One year?

Mr. Stein: A one year agreement. I will come back to that, sir, it is very, very interesting, if you have the time.

Senator Bourget: It certainly is.

Mr. Stein: No sooner was the plumbers' strike settled than another union went out on strike and the job still did not open. Can you visualize, in a province like British Columbia, 54 individual trade negotiations in our industry? Now, just think of the pressure that this creates if one union lags behind. In British Columbia, for example, the plumbers' union and the mechanical contractors signed an agreement for five years. In the course of that five years they were surpassed by the other unions who negotiated in between and so where they were second in order of wage scales when they signed this agreement they dropped to sixth place. So naturally they went on strike to get back to second place and this system of separate negotiation just creates a structure where you go from plateau to plateau to plateau because it is a challenge to each and every negotiator for his union to do a little better than the other fellow did.

Senator Carter: Do they have any special right to the second place?

Senator Robichaud: They claim they have.

Mr. Stein: In the Province of Quebec, sir, it would be called the *droit acquit*, the acquired right.

Senator Carter: Where do you set up your criteria for a fruitful avenue of research. I think that is what happens all the time.

Mr. Stein: Exactly, except what you have when you have what we call multi-trade, multi-party relations. As a classic example, you have in the Province of Quebec Bill 290. There is a strike in Quebec City but it is an industry strike and despite the fact that in the Montreal area there is no signed agreement, no Parity Committee, and no administration of the Collective Agreement Act, the settlement was 5½ per cent and the industry is working.

Senator Bourget: Was it settled?

Mr. Stein: Yes, and the men are working because if there is a strike it is an industry-wide strike. You do not have the conditions where a small group can jeopardize the livelihood of thousands and thousands of people. There is an imposed responsibility both upon labour and on management, and, honourable senators, we feel very, very strongly that the measures which we recommend would benefit not only the employers but they would benefit labour. They would do away with a rivalry

between individual craft unions, and they would benefit the economy on this kind of a basis, with multi-trade, multi-party, industry-wide labour-management relations. You can then take into consideration all the important factors which determine the wage scales and these now become productivity, cost of living index and whether or not the economy can support the demands.

Senator Robichaud: Would this be one of the best anti-inflationary measures to be introduced?

Mr. Stein: Yes, sir, we have that. I am glad to hear you say it, sir.

The Vice-Chairman: What party can you sell it to?

Senator Bourget: There are strikes not only in your own industry, construction, but in transportation, at seaports, and so on—some strike one year and others the next.

Mr. Stein: That is correct.

Senator Bourget: So it is a very, very, very important problem.

Mr. Stein: We are very much concerned with construction, it is the largest industry. We are talking in terms of 600,000 people on site and we are talking of a \$4.5 billion payroll for the year.

Senator Carter: Do you all have so much in common? You have got to be such a big conglomeration, wouldn't you be better organized if you could split yourself up into groups that had more in common?

Senator Bourget: You would go back to the union then.

Mr. Stein: We have a community of interests, sir.

Senator Carter: Yes, but at the same time I think it is probably the only industry in Canada where the bulk of the work is done by small to medium-sized companies rather than one giant company.

Senator Kinnear: I was wondering if there is not a lack of communication among your own people.

Mr. Stein: No, I think we have a pretty good line of communication between the national, the provincial and the local associations. Our difficulty, I must repeat is the fact that membership is voluntary and only

members of the association have contributed in time, in effort and in financing to the aims and objectives of the association.

Senator Robichaud: I am referring to enabling legislation now, legislation of the kind that you are suggesting. Would there not be a major problem of provincial jurisdiction involved?

Mr. Stein: Not necessarily. If we are talking in terms of an industrial development fund which helps all of Canada it could very, very well be attached to an existing national assessment scheme, for example, as they do in France. If you are talking of licencing of contractors, if you are talking of workmens' compensation, then it becomes provincial.

Senator Robichaud: That is what I had in mind.

Mr. Stein: May I just say a word, sir, on this, on what can be done. Just a few examples of what can be done with a form of industrial development fund is that in the Province of Quebec, by virtue of the Collective Agreement Act, there is a joint committee to administer them and there is a contribution of one-half of 1% of payroll by both employers and employees to cover the cost of the administration of this joint committee. Up till quite recently the surplus funds were turned over to the apprenticeship centres and Quebec has the best system of apprenticeship training in all of Canada. This could be challenged by some of our western members but...

Senator Bourget: Are you talking about Le Comité Conjoint de la Construction?

Mr. Stein: Yes. Le Comité Conjoint de l'Industrie de la Construction de la Région de Montréal. In Ontario a special assessment is made, attached to the Workmens' Compensation levy. This generates \$1.8 million per annum and this is devoted entirely to a construction safety education programme and this has had excellent results.

In British Columbia, where industrial development funds are in existence and they are attached to labour agreements, these funds have been used for certain promotional work and they have also been used for education and training. They have been used for training labourers, for example, not so much the skilled trades but the unskilled trades in things like handling, placing and vibrating concrete and in compacting soils and so on,

and they have shown there that this kind of education has resulted in better productivity by those people who have been taking these courses. These are direct examples of what can be accomplished with an industrial development fund. They have produced a beautiful film called "Careers In Construction". This is the story of a young high school student out on the construction site and thinking of a career in construction. This tells him what he can do and what his potential is, whether at the technician's level or management level or professional level. The film covers all this and this is good industrial development.

Senator Carter: You keep stressing the voluntary aspect over and over. Is everybody in or are there still some companies outside the veil?

Mr. Stein: Oh, there are many companies who are not in.

Senator Carter: How many, what percentage?

Mr. Stein: Would you have the figures, Mr. Chutter, a guess, a percentage?

Mr. Chutter: This is one of the problems regarding statistics. If you ask how many construction companies there are, there is no answer, at least one that can be defended. We like to think that the majority of the major companies either belong to our national association or to its affiliates. When we made an estimate a couple of years ago it was that the combined memberships of our various member associations was something in the nature of 12 thousand. The estimate of the total number of construction companies would start probably at about 35 thousand and go on up depending on the numbers in the yellow pages in the phone books across Canada.

Senator Kinnear: I was looking up on steel companies. I thought you would have Atlas Steel, are they a member?

Mr. Johnson: They are not a member of our organization. Our organization is primarily concerned with the fabrication of steel. Their area is a little different from that.

Senator Kinnear: They are still fabricating.

Mr. Chamberlain: Atlas is more in the field of primary steel production.

Senator Kinnear: Yes, but they have their cold rolled.

Mr. Chamberlain: Yes, in terms of our definition of fabrication that is still a raw material to us.

Senator Kinnear: It has to be a manufactured product?

Mr. Chamberlain: It has to do with manufacturing, the production of these mills is for steel beams, bridges, things of that type.

The Vice-Chairman: Ladies and gentlemen, some members of this committee have to attend other committees right after lunch. We are running behind. This is a very big subject, a very practical subject. I am not sure but that you have raised more questions than you have answered. It may be that we may wish to ask for further submissions from you, for example, on the matter of legislation. I think we need more clarification of just how you would like to see this brought out. You suggested the idea, and I think it may be essential for us to hear more on that. You have put your finger on a number of sore spots, such as the conflict between the building codes, and yet you have not spelled out how we could cope with it. I think we will need some further assistance in that area, and there are others you have emphasized too.

I am sure this committee is sympathetic with the disproportionate amount of money being spent on basic as opposed to applied research. You have not suggested how we would carry out the applied research, at least to the extent that I would like to see it spelled out. I know it is not easy, but these are the kinds of questions that this committee has to try and find answers to. If I may speak for the committee, we would welcome a little further elaboration on these points particularly. It can be done by supplementary letter rather than a brief on these three points, and there may be others.

Senator Robichaud: Those are the three main points that could be elaborated upon.

The Vice-Chairman: Yes, so if we could have this at your early convenience we would appreciate it. We are trying to hear all the briefs and make specific recommendations. So you would be very helpful to us if you could give us this further elaboration.

Mr. Stein: We will do our utmost, sir.

The Vice-Chairman: May I compliment you on your briefs. I read these briefs but I did not ask many of the questions I would like to have asked. The briefs are very practical.

This is the basic industry in this country, so we are grateful to you for the contribution you have made and we would like to feel we can call upon you for further elaboration if required.

Senator Carter: And I would add, Mr. Chairman, that I would like to know whether the construction industry in Canada will be able to come up with any innovations.

The Vice-Chairman: They have but they can answer that themselves.

Senator Carter: It is not in their brief but it would be nice to have it on record.

The Vice-Chairman: Precast concrete alone is one of the recent innovations.

Mr. Stein: There has been, sir, a continuous program of innovation, nothing spectacular, nothing dramatic, nothing publicized, so called break-throughs, but there has been constant evolution and constant development.

The Vice-Chairman: Thank you, very much.

Mr. Stein: Thank you, sir.

The Committee adjourned.

APPENDIX 129

CANADIAN CONSTRUCTION ASSOCIATION



SUBMISSION

to

SPECIAL SENATE COMMITTEE

ON

SCIENCE POLICY

April 15, 1969

CONSTRUCTION HOUSE, 151 O'CONNOR STREET, OTTAWA 4, CANADA

CANADIAN CONSTRUCTION ASSOCIATION

CONSTRUCTION HOUSE, 151 O'CONNOR ST.,
 OTTAWA 4, CANADA
 AREA CODE 613/236-9455



BRIEF
 TO THE SENATE OF CANADA
 SPECIAL COMMITTEE ON SCIENCE POLICY

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CANADIAN CONSTRUCTION ASSOCIATION

CONSTRUCTION HOUSE, 151 O'CONNOR ST.,
OTTAWA 4, CANADA
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Brief to the Special Committee on Science Policy
of the Senate of Canada, April 15, 1969

SUMMARY

The construction industry is Canada's largest, with an estimated volume this year of \$13.3 billion. Construction outlays in Canada have on average accounted for roughly one-fifth of the G.N.P. They provide direct employment to 600,000 Canadians and an even greater number off-site.

The industry is dynamic in character. The size and complexity of projects have increased enormously in recent years. Many of the techniques, materials, components, skills and pieces of equipment commonly used in both engineering and building construction are of recent origin.

The CCA was established in 1918 to represent the contracting and supply aspects of the construction industry at the national level. It now has over 2700 member firms and over 100 member associations. The recommendations contained in this brief also have been endorsed in principle by the National House Builders Association.

Main Conclusion

A great deal of scientific research related to construction has been carried out by the Federal Government and other public agencies and by the Construction Industry. However, in view of the size and importance of the construction programs in terms of Canada's G.N.P. and economic development, much more is needed in both the public and private sectors. This is all the more so in the light of predictions of very substantial increases in the demand for construction services in the future.

In the case of the Federal Government, expanded research activities and the offering of more effective research incentives are recommended. In the case of the Construction Industry, the main need is for 'operational' research work of a general nature to supplement the activities of individual firms or specialist associations mainly concerned with specific products or trades. Inasmuch as the Industry is comprised of many thousands of firms of which only very rarely does one have more than 1% of the total construction market, the Association believes that needed research by it on construction techniques and methods, education and training, labour relations, economics, etc. will best be done collectively, financed by a Construction Industry Development Fund, supported by legislation.

Specific Recommendations

1. The program of the National Research Council, Division of Building Research, should be expanded (p.6)
2. Uniform building standards (by-laws) should be adopted throughout Canada (p.6)
3. The proposed Standards Council of Canada should be formed this year (p.6)

4. Priority should be given to a study on the implications of the conversion to the Metric System, including a schedule and related requirements for construction operations (p.7)
5. The B.E.A.M. Program of the Department of Industry should be continued (p.8)
6. The Program for Advancement of Industrial Technology (PAIT) should be amended to accommodate a broader concept of industrial research and interest charges removed from repayment requirements (p.9)
7. The Industrial Research and Development Incentives Act should be amended to delete the five year base period requirements for operating and development grants (p.9)
8. The research incentives available to manufacturers through the National Housing Act should be studied with a view to expanding their use (p.10)
9. A Central Information Service should be established to provide authoritative advice on the various research incentive plans offered by the Federal Government (p.10)
10. An Advisory Committee should be used by the Federal Government to advise on the allocation of research funds and the priority of projects with respect to the construction industry (p.10)
11. More research activities should be carried out on an industry basis in the fields of Education and Training, Labour Relations, Business Practices, Economics and Statistics, Technological Research and Planning (p.16)
12. A Construction Industry Development Fund should be established, supported by legislation, to enable the industry to carry out research and development work of a general nature and make it less dependent on the Federal Treasury (p.16)

CANADIAN CONSTRUCTION ASSOCIATION

CONSTRUCTION HOUSE, 151 O'CONNOR ST.,
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15th April, 1969

Hon. Maurice Lamontagne, Chairman,
and Members of the Special Committee
on Science Policy of the Senate of Canada.

Honourable Senators:

1. The Canadian Construction Association very much appreciates this opportunity of presenting its views to the Senate Committee on aspects of the Physical and Human Sciences relating to the Construction Industry, as part of the Committee's review of Federal Government science policies. The Industry is undergoing widespread and significant changes; a review of science policies is therefore most timely. The Association's objects are listed in Appendix "A". This Brief is presented on behalf of its nation-wide and industry-wide membership of over 2,700 leading firms (general and trade contractors, road builders and heavy construction firms, manufacturers and suppliers of construction materials and equipment, allied professions and services) and over one hundred member construction associations (Appendix "B"). The latter in turn have a combined membership in excess of 12,000 firms. The bulk of the contract construction program is carried out by members of the CCA and its Affiliates.

MAIN CONCLUSION

2. A good deal of scientific research related to construction has been carried out, both by the Federal Government and other public agencies and by the Construction Industry. However, in view of the size and importance of the construction programs in terms of Canada's gross national product and economic development, much more is needed in both the public and private sectors.

3. In the case of the Federal Government, expanded research activities and the offering of more effective research incentives are recommended. In the case of the Construction Industry, the main need is for 'operational' research work of a general nature to supplement the activities of individual firms or specialist associa-

tions mainly concerned with specific products or trades. Inasmuch as the Industry is comprised of many thousands of firms of which only very rarely does one have more than 1% of the total construction market, the Association believes that needed research by it on construction techniques and methods, education and training, labour relations, economics, etc. will best be done collectively, financed by a Construction Industry Development Fund, supported by legislation.

SIZE AND NATURE OF THE INDUSTRY

4. The Construction Industry is Canada's largest and operates in all sections of the nation. The value of the construction program is estimated this year to be some \$13.3 billion. Construction outlays in Canada have on average accounted for roughly one-fifth of the G.N.P. and now provide jobs in construction operations to the year-round equivalent of some 600,000 Canadians and to an even larger number off-site engaged in the manufacturing, transportation and merchandising of construction materials, components and equipment. So much of the Canadian economy relies on the construction program that its future should be of general concern to all Canadians.

5. This construction program is made up of approximately 60 per cent building construction and 40 per cent engineering and heavy construction (roads, bridges, municipal services, power projects, canals, pipelines, dredging, airports, etc.). Approximately one-half of all building construction is in the residential field, so that nearly one-third of all construction in Canada is for the provision of homes. The balance consists of institutional, commercial and industrial buildings.

6. The Industry is not concentrated in a relatively small number of large firms (like the steel, electrical goods, automobile and pulp and paper industries for example) but is comprised of many thousands of firms spread over the whole country. Construction is carried out from coast to coast and from the Canadian-USA border to the Arctic engaged in a wide range of construction projects from a small dwelling unit to vast high rise buildings and industrial complexes. Canadian designers, constructors and manufacturers are now extending their construction operations in foreign lands.

7. The Industry operates under peculiar difficulties. It is subject to more regulations at all levels than other industries. Its activities are not carried out under controlled conditions which are applicable to other industries. It is subjected to

extremes of climate and terrain. It is a very mobile industry; its place of operations continually change. Its programs are affected by the seasonal and cyclical swings in the demands for its services. Most projects are "custom" designed. Many of the major projects are in isolated areas.

8. While the changes in the Industry operations has led to some overlapping of functions, the Industry's innumerable units can conveniently be broken down into four major groups, each with its own research capabilities and/or needs.

9. (a) Designers - The design of most construction projects is carried out by members of the professions of architecture and engineering, the "design professions". Their work involves initial studies, the preparation of designs and contract documents, and often the supervision of construction. Only a few of the consulting firms will have a staff larger than one or two hundred.

10. (b) Contractors - An even larger group of units is provided by the contractors, the organizations that carry out the job of converting the paper designs to actual structures or installations. The group includes both general contractors, who will take an overall contract for the completion of an entire project, and specialist or trade contractors who undertake sections of construction work in specialized fields such as electrical, mechanical, structural steel, pre-cast concrete, roofing, plastering, painting, elevators, etc. Again, the size of organization varies greatly, ranging from general and trade contractors who carry out many million dollars worth of work in a year to one-man specialty contractors whose annual volume of work does not exceed \$10,000.

11. (c) Manufacturers and Suppliers - New types of construction materials and components and an ever-increasing array of specialized equipment are being continually introduced. These are provided by a large number of industrial companies that manufacture products under controlled conditions in established plants. Some are large firms which maintain their own research facilities. "Manufacturing Contractors" are those whose own crews install their products on the job site. The trend towards off-site fabrication has increased in tempo in recent years and sometimes involves the entire structure or major portions of it.

12. (d) Construction Manpower - The importance of the human element in the construction process should not be overlooked and equal attention must be given to this area to parallel attention being given to the technological side. The Industry's

manpower resources are very diversified and include skilled craftsmen, equipment operators and other members of the on-site labour force; construction technicians; supervisory and administrative personnel; and construction management, many of whom have had professional training. Theirs is the responsibility of applying the results of technological advances and executing construction projects of steadily increasing size and complexity.

13. A unique feature of the labour force in the Construction Industry is that, because of the mobile nature of construction operations, it is commonplace for an employee to work for several employers and at diverse locations within a year's period.

14. (e) Ancillary to the major groups of the Industry are some specialist services. The commercial testing laboratories of Canada constitute one such group, essential for the independent testing of building materials and components. The Division of Building Research, National Research Council, is another special service, providing research facilities and a centre for technical information needed by the Industry. Other services include surety and insurance companies and the trade press.

15. Research and other scientific policies designed to improve the overall efficiency of the Construction Industry may be divided into the following principal areas:

- i) Economics -- e.g. programming, monetary, fiscal and other measures designed to achieve greater stability in the construction growth-rate. This is the main basic need.
- ii) Technological -- e.g. new or improved construction materials, equipment, techniques, industrialization, etc.
- iii) Managerial -- e.g. organizational matters, labour-management relations, business practices, etc.
- iv) Educational -- e.g. the training of those involved in the various aspects of the construction process, at all levels.

FEDERAL GOVERNMENT SPHERE

The Division of Building Research, National Research Council of Canada

16. This Division was established in 1947 and constitutes the main agency in Canada involved in technological research related to the construction program. Its

formation recognized both the desirability in terms of the public interest of increased construction research activities and the difficulties faced by the Industry in executing job-site research work and that not related to products of an individual firm or section of the Industry.

17. From the start there has been close and continuing liaison between the Division and the Canadian Construction Association and the Construction Industry in general. DBR became a full-fledged member of the CCA in 1947 and its representatives have actively participated in the Association's committee work and Annual Meetings throughout the ensuing years. The CCA in turn has held Board and Committee meetings from time to time at DBR; distributes the Division's monthly Building Notes to its entire membership; is represented on the Building Research Advisory Committee and the Associate Committee on the National Building Code; and provides free display facilities to DBR at Annual Conventions.

18. It is perhaps worth stressing that all of DBR's projects are of an "applied" (or practical) research nature, initiated in response to requests made by members of the Industry or public agencies concerning actual or anticipated job-site problems. Also, that this Division publishes an Annual Report describing its projects and services in detail. This and lists of other publications available from DBR are widely distributed. Each of the major groups within the Industry (i.e. architects, engineers, contractors, manufacturers and labour) are represented on its Advisory Committee. DBR maintains close operating liaison with other research agencies in Canada such as the Forest Products Laboratories and with national Building Research establishments throughout the world.

19. The Association has in the past commended in its Briefs to the Federal Cabinet the work carried out for the Government and the Industry by this Division of the National Research Council, covering many aspects of construction practice, and in operating the Associate Committees on the National Building and Fire Codes of Canada.

20. It is noted that the Government intends to step up research activities, especially in the housing field. (The Division acts as the technical research arm of Central Mortgage & Housing Corporation). Unfortunately the Division is already under strength with respect to its present research activities and the commencement

of new projects have had to be postponed. It is also in need of secretarial staff with regard to the preparation of the fifth edition of the National Building Code. This book is scheduled to be available on January 2, 1970. It will contain many important revisions and is being eagerly awaited by the Industry and municipalities across Canada. Here again, the adoption of the Code is strongly recommended by the Federal Government and the Association alike.

21. It is understood, however, that the activities of the Division in these important fields are being impeded by the Government's "freeze" on hirings imposed last year. It is sincerely hoped that, now that the Government has had a chance to assess its various programs and priorities, due attention can be given to important areas such as this instead of a blanket order which places an embargo on the recruitment of new staff in all departments and agencies.

22. The Association appreciates the fact that a new specialty laboratory building is now under construction for the Division in Ottawa. Additional work could be conducted in the Division's existing facilities without delay. It is strongly recommended that authority be given to expand DBR's staff and thereby expedite work on the backlog of deferred projects and those whose completion has been delayed.

Building Codes and Standards

23. In order to make it possible for the Building Industry to proceed to the more advanced stages of industrialization, effective standardization is an absolutely indispensable pre-requisite. The absence of uniform building standards is a deterrent to research and development because of a lack of assurance to manufacturers that the new products will be permitted by the various municipal building by-laws. The CCA has long advocated the general adoption of the National Building Code of Canada and its supplements including housing standards to facilitate uniformity, safety, efficiency and economy in construction.

24. The announced intention of the Federal Government over a year ago to establish a Standards Council of Canada was welcomed by the CCA and it urges that the Council be formed without further delay. The Association's interest in the Council are three-fold: (1) The Construction Industry is subjected to more standards than any other Industry and serious delays are now being experienced in their establishment or revision. (2) The Council will likely be responsible for developing a plan

and schedule for the orderly conversion to the Metric System of Measurement in the Construction Industry. (3) The Council is suggested as being the appropriate body for handling the continuing promotion of modular co-ordination.

25. With specific reference to the Metric System, it is in mandatory legal use in countries containing almost 90% of the world's population. It is believed that "metrication" is inevitable in Canada, especially in view of its status as a trading nation. The Association has followed with interest the conversion to the metric system of measurement now under way in the construction industry in Great Britain. Progress has been rapid. Many who are employed in the construction industry and allied professions of architecture and engineering in Canada have emigrated from metric countries. Conversion here accordingly should be relatively more easy to accomplish because of this and the fact that we can benefit from the U.K. experience and the guidelines set forth by a British Standards Institution group chaired by a contractor. The American Society of Testing and Materials, whose standards govern many construction items in Canada, has already included metric units for all of its standards. The CCA believes that conversion to the Metric System will be a further aid to uniform standards.

26. In June, 1968, the CCA National Council adopted a Motion recommending that the Federal Government take prompt action -

- 1) to expedite the establishment of the proposed Standards Council of Canada
- 2) to direct this Council to carry out a study of the implications of the conversion to the Metric System of Measurement in Canada
- 3) to include in the study, in collaboration with the construction industry and allied professions, a proposed schedule and related requirements for the conversion to the metric system in construction operations in Canada
- 4) to enact legislation providing for the conversion to mandatory use of the metric system of measurement in Canada.

This Motion was confirmed at the Association's Annual Meeting in January, 1969.

BEAM Program

27. The Association is pleased with the continued support of the BEAM Program (building equipment, accessories and materials) by the Department of Industry, Trade and Commerce. The work of the various Advisory Committees has also been productive and very considerable interest has been shown generally among manufacturers, contractors, architects and consulting engineers in the various projects in the Program designed to increase productivity and efficiency in the provision of construction facilities. Modular design and industrialized techniques for construction are cases in point.

28. The CCA was very pleased to act as a co-sponsor with the Department and the Royal Architectural Institute of Canada and the Association of Consulting Engineers of Canada of the conference on A Systems Approach to Building, held in Ottawa last April. This was well attended and most successful. Such co-operative efforts as this are to be commended and should form part of a continuing program.

29. We have been pleased to participate in the feasibility studies and preliminary planning and organization of a comprehensive construction information system, another integral part of the BEAM Program. The Association has long supported this concept.

FEDERAL GOVERNMENT INCENTIVE PLANSTO ENCOURAGE RESEARCH BY INDUSTRYProgram for Advancement of Industrial Technology (PAIT)

30. "The basic principle of this program is to help Canadian industry to upgrade its technology and to expand its innovation activity by underwriting specific development projects which involve a significant technical advance and which offer good prospects for commercial exploitation. Of the 160 projects approved since the inception of PAIT, only three have been for the Construction Industry. It has been unable to take full advantage of PAIT because of the requirement in the "Project Criteria" that projects "should result in a substantial technical advance". This tends to be too narrow. If emphasis was placed on "product innovation", the Construction Industry could be accommodated to a greater extent.

31. Under the Terms of the PAIT Program, repayment with interest is a requirement should the project be successful. Although there could be no quarrel with the repayment aspect, the interest requirement tends to make the financial incentive less

attractive. In fact, upon analysis, PAIT money is relatively expensive money with respect to other incentive programs.

32. It is accordingly recommended that the PAIT Program be expanded to accommodate a broader concept of industrial research including product innovation and that interest charges be removed from the repayment requirements.

Industrial Research and Development Incentives Act

33. Under this Act all capital research expenditures are eligible for a tax-free grant of 25 per cent. This undoubtedly helps to produce an orderly growth of industrial research facilities in Canada. Companies within the industry are taking advantage of this provision and there appears to be a general satisfaction with it and the fact that the processing of applications has been expedited.

34. Under the Act the tax-free grant of 25 per cent is also available for certain research operating and development expenditures. It, however, only applies to the increase in expenditures over a base comprising an average of those incurred during the previous five-year period. This five-year averaging period has a tendency to make it difficult for companies to share in the benefits of the program during years of recession or at times when market conditions are such that research funds are not as readily available.

35. It is recommended that the five-year base period be eliminated.

Part V - National Housing Act

36. "Under the Terms of Part V of the National Housing Act (1954) funds are available from Central Mortgage & Housing Corporation to support a variety of programs directed towards the improvement of housing conditions and the development of Canadian communities. These programs are generally concerned with economic, social and physical aspects of urban and regional development, community planning and the design and construction of housing and related facilities. They may be in the form of research, studies, training and information material."

37. The Part V Grants are comprehensive in scope and most interesting from the point of view of the Construction Industry. For example, the grants to the

National House Builders Association to assist it in financing the construction of experimental low cost houses have been very helpful. Also, the grants available to manufacturers for the experimental production of components used in housing appear to be more attractive than those available under other Federal incentive programs.

38. To date, relatively few of the latter type of grant (under Section 33(l)(f)) have been applied for. Perhaps this lack of activity could be overcome by increased publicity. At any rate, it is suggested that the program be reviewed with the object of expanding its operations. Moreover, it is recommended that the limitation in Section 33(2) be deleted whereby it is provided that CMHC may only enter into contracts with manufacturers to underwrite or guarantee the sale of housing components if they are made for installation in farm or rural homes.

Industrial Research Assistance Program

39. This program, established by the National Research Council, is oriented around long-term research programs through the establishment or expansion of industrial research teams. It is related to the phase long prior to production; the other incentive programs have therefore more application to the construction industry.

General Recommendations Concerning Incentive Programs

40. The above-mentioned incentive programs designed to encourage research activities by Industry are administered by three different agencies. It has been stated that difficulties have been encountered in obtaining comprehensive advice on the possible application of these programs to a specific project and that this has tended to discourage some potential users. It is recommended that a central information service be established to advise interested parties authoritatively of the details of the various incentive programs available to them.

41. Also, in view of the size and complexity of the Industry and the scope of the various Federal research activities and incentive programs related to it, the use of an Advisory Committee is recommended to advise on the allocation of Federal research funds and the priority of projects. Such consultations might also review the fact that, whereas general incentives are available to stimulate research, development and innovation in the technological field, there are no equivalent incentives offered in the equally important field of 'operational' research. The latter may be just as rewarding in terms of increased efficiency and economy.

RESEARCH BY THE CONSTRUCTION INDUSTRY

42. Research and development in the Industry for the most part has been carried out by the manufacturing and supply sections of the Industry and the specialty trade and product associations. In addition, many firms in the Industry have benefited from research done in other countries. In some cases Canadian firms financially support research work in the U.S.A. For example, the Portland Cement Association maintains a large research laboratory in Skokie, Illinois. While there has been a substantial involvement by these areas of the Industry in research and development which has made a very large contribution to product improvement and efficiency, the contracting side of the Industry has been unable because of lack of individual company resources and the absence of a coordinating body with the necessary funds to implement research programs in areas of general concern and application.

'Operational' Research

43. As mentioned previously, it is believed that due emphasis in this regard should be placed on the 'operations' side of the industry -- i.e. that in addition to advances in the physical sciences and construction technology, it is vital that progress also be made in the other sciences and factors affecting construction efficiency.

44. The main basic problem in the industry has been the high degree of instability in the growth-rate. This in turn has been the main factor causing unstable labour relations and employment, unstable production runs and markets and instability in the work loads carried by design offices and contracting organizations. The buyers of construction services have shared in the impact of these conditions in terms of end costs. Because of the size of the construction program, there is also a very considerable impact on the overall economy.

45. Notwithstanding the importance of these matters, relatively little economic research has been devoted to construction cycles and the influence of monetary and fiscal measures on the volume and timing of construction projects. Recently the Economic Council of Canada has stressed the importance of these subjects and has urged that governments plan and programme their own construction projects so as to help to stabilize the construction growth-rate rather than to aggravate the swings

in the construction cycle.

46. Similarly, it is essential that the industry and the public bodies which govern its operations are geared to handle the results of research and development work in construction technology. Prolonged work stoppages, outmoded building codes, lack of skilled personnel, etc. could offset the benefits of technical progress. Once again, these fields have not, relatively speaking, apparently received the same amount of attention on the part of the industry, the universities and others as has been the case with industries which are more cohesive and concentrated in character. This situation also very definitely obtains in the U.S.A.

47. This is not to suggest that the industry is unaware of these needs or that it has not endeavoured through its associations to meet them. As recent examples, the CCA submitted a Brief to the Canadian Deans of Engineering in support of more 'practical' content in courses leading to careers as construction engineers; it has sponsored construction management courses throughout Canada; and it co-sponsored with the N.R.C. Division of Building Research and several other public agencies a comprehensive pilot project on Work Study on Building Sites.

48. In several instances the Association has turned to the Federal Government to execute or assist in projects for which the available resources were insufficient. Examples include the promotion of modular co-ordination and other aspects of the BEAM Program, a "Functional Analysis of the Construction Industry" and "An Analysis of Building Construction Technology and Supervision".

Labour Relations Inquiry

49. The Industry's largest research project to date has been the Canadian Inquiry on Construction Labour Relations. As a centennial project of lasting value, in 1965 the Canadian Construction Association demonstrated its readiness to take a serious and responsible step to solve many of the Industry's labour relations problems by commissioning, at a cost of \$128,000.00, a major inquiry into the main problem areas affecting construction labour-management relations and the structure, operations and organization of its labour force. Relatively little research had ever been done in these areas. The effects of technological change, manpower forecasting and training, machinery for solving jurisdictional disputes, the impact of unstable demands on the Industry's products and services, wage determination, multi-party and multi-trade

bargaining, contractor association accreditation and labour legislation are but a few of the critical subjects researched. A total of twelve problem areas were studied by noted specialists in each field who were given a completely free hand in defining the scope of their investigation and in dealing with the subject which they undertook. These twelve were selected as being related to the most serious problem areas in construction labour-management relations. The research was co-ordinated and analyzed by two of Canada's most highly respected authorities on labour management problems, Doctors H. Carl Goldenberg of Montreal, who chaired the Inquiry, and John H.G. Crispo, Director of the Center for Industrial Relations, University of Toronto, who assumed responsibilities for directing the research. A Steering Committee consisting of senior labor and management representatives worked with the research group throughout the project.

50. The detailed research studies along with the conclusions and recommendations of Doctors Goldenberg and Crispo were published in a 670 page English Volume and a 763 page French Volume in late 1968. The findings of the Inquiry have already proven to be highly significant and have enabled the Industry, for the first time, to acquaint our legislators with the peculiar needs of the Construction Industry in labour relations legislation. Since the conclusions and recommendations were first revealed in January, 1968, management in the Industry has been hard at work restructuring and augmenting its resources to permit it to implement the recommendations and properly discharge its responsibilities to its employees, its customers and the public. The findings of the Federal Government's own \$1,000,000.00+ Task Force on Labour Relations have since emphasized the validity of the findings and recommendations which flowed from our Inquiry and which will continue for many years to guide efforts to stabilize our Industry's industrial relations.

51. As important as the project was, the financing of it proved to be a most difficult task even though the cost represented only approximately one three-thousandths of one percent of the construction volume in Canada during the three years of research. The cost of the ambitious but much needed project could not be underwritten from regular association revenues and it was necessary to appeal for voluntary contributions from members and affiliated associations. These contributions from 132 individual

companies and 58 affiliated associations plus sales of the volume to date have produced revenues of approximately \$100,000. The Canadian Construction Association, in addition to providing staff resources, has assumed the responsibility for the balance of the cost of the project and, as a result, defer other important services to its members. Had it been possible to distribute the cost of the inquiry equitably among all companies doing business in the Construction Industry, the cost to each would have been approximately seven cents per year, per employee engaged in on-site construction, over the three year period.

52. Other areas of research and development being carried out or studied by the Association directly, or by its member associations, are:-

(i) Education and Training

- (a) Development and sponsorship of management and supervisory training courses designed to increase efficiency and productivity in the Industry.
- (b) Liaison with the universities, technological institutes, trade training centres, etc. -- development of construction engineering, technician, upgrading, etc. courses; scholarships and bursaries; grants for teaching personnel to take summer employment in the construction industry, etc.
- (c) Development of a comprehensive program designed to promote entry into Construction Careers of suitable personnel.
- (d) Seminar program covering new techniques and developments in construction operations and administration, construction safety, association management, etc.
- (e) Development of trade and objective training courses to fill the gaps exposed by the Functional Analysis of the Construction Industry which has been recently completed.
- (f) Dissemination of information helpful in the operations of construction businesses.

(ii) Labour Relations

- (a) Continuation of research program related to the Canadian Inquiry on Construction Labour-Management Relations, with a view to achieving more stable and mature conditions in this field, and therefore increased productivity.

(Note: The Inquiry comprised studies during 1965-67 covering 12 selected problem areas. Two follow-up studies by the CCA were completed in 1968. Industrial relations are evolutionary in character and these and other subjects will require continued attention.)

- (b) Development and sponsorship of courses for industrial relations personnel in the construction industry and to achieve a better understanding of labour relations matters generally.

(iii) Business Practices

- (a) Detailed study of construction business procedures (holdbacks, securities, liens, documentation, credit, etc.) with a view to expediting Cash Flow in construction operations.
- (b) Increased development and revision of standard forms of tender, contract, rental agreement, etc., bidding procedures, contract administration guides, etc.
- (c) Detailed study of Taxation as it affects construction company and industry operations.
- (d) Development of practicable systems designed to identify competent firms, to the advantage of Owners and members of the industry alike.
- (e) Development of Specification and Performance Standards.
- (f) Research on legal responsibilities of contractors under changing conditions with respect to relationships with owners and designers, etc.

(iv) Economics and Statistics

- (a) Promotion of studies designed to stabilize the growth-rate of the construction program.
- (b) Promotion of the development of statistics measuring construction volume, costs, employment trends, etc. in greater detail and with greater speed and accuracy.
- (c) Encouragement of the preparation of more frequent annual and medium-term Construction Volume Forecasts.

(v) Technological Research and Planning

- (a) Support of research activities of NRC, universities and other research bodies and of component parts of BEAM Program and initiation of complementary projects.

- (b) Promotion of five-year planning and programming of construction outlays by major Owners, both public and private.
- (c) Promotion of co-ordinated planning in the development of major national resources and transportation facilities.

53. Progress in these projects has been appreciable but it has been slow and inadequate. The Industry's operations have been changing at a much faster rate of late and much larger future construction programs are widely predicted. It is therefore all the more important and in the public interest that increased attention be given to these programs and progress greatly accelerated.

CONSTRUCTION INDUSTRY DEVELOPMENT FUND

54. A Construction Industry Development Fund would enable the Industry to expedite needed research and development work of a general nature and make the Industry less dependent on the Federal Treasury. The Association in its annual submission to the Federal Cabinet in September, 1968, pointed out the need for such a Fund whereby the Construction Industry would be enabled to finance research projects, educational programs and other activities that would facilitate the industry development and increase its ability to meet the demands for its services efficiently and economically. Individual construction companies don't have the financial resources to permit them to conduct any significant 'in house' research. By pooling their resources, however, they will be enabled to participate in a comprehensive and effective research program. Only through such a Fund, uniformly assessed on all construction, can the Industry perform a proper research and development function.

55. Examples of these funds exist in Canada, but not yet at the national level. The \$1½ million budget of the Construction Safety Association of Ontario is financed by a percentage of the workmen's compensation assessments paid by all contractors. The Board of Directors of the CSAO is comprised of a representative group of contractors. In Quebec, the Collective Agreement Act requires a 0.5% payroll assessment from all contractors and their employees. These funds, which are used to administer labour agreements extended by Government decree and to help pay for the operation of local trade training centres, are administered by joint committees in each region. In addition, there are a number of industry funds in which employers contribute an extra amount along with welfare plan payments called for by Local and Provincial Labour Agreements.

56. There are, however, many worthwhile projects which are appropriate for and more economically handled at the national level. Moreover, there would be obvious advantages in terms of coverage and equity if such an Industry Development Fund were operated on a national basis.

57. The proposal for Industry Development Funds enjoys widespread support in the Industry. A very minor assessment would generate appreciable monies for the proposed Fund. The potential benefits to not only the Construction Industry but also to its customers and the general public would be great. In the past, efforts to carry out worthwhile projects have been stymied through lack of funds and the difficulty of collecting contributions on a widespread basis.

58. With regard to methods of financing such activities, the Association in its submission to the Federal Cabinet suggested that the Canada and Quebec Pension Plans afforded scope for economical collections. The over-payments by construction employers to these plans are morally funds belonging to contractors. Even the interest on non-refundable over-payments by construction employers would get the Fund off to a good financial start. Then again, contractors' contributions to the Unemployment Insurance Fund could be increased slightly and the proceeds transferred to the Construction Industry Development Fund. Alternatively, supporting legislation could require assessments to be paid by all contractors to the Fund, with the latter absorbing collection costs.

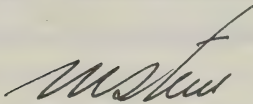
59. In South Africa, for example, payments into the National Development Fund for the Building Industry are required by law to be paid by all contractors, based on payrolls. In France the National Government co-operates by allowing contractors' contributions to be collected as an extra amount to assessments levied in connection with its vacation pay scheme. These funds are turned over in bulk amounts to the employers' organization. This type of arrangement enables large numbers of amounts (many of which may be relatively small) to be collected very economically.

60. The National Industry Funds vary in detail but all have a common feature: all members of the Industry contribute to them and thereby help to finance the program being executed to aid the development of their Industry. An Industry Development Fund would also make the Industry more self-reliant and reduce the requests made to Government for assistance. Legislative support or co-operation in the collection of contributions to such a Fund would be most welcome.

CONCLUSION

61. It is sincerely hoped that the above recommendations commend themselves to the Special Senate Committee on Science Policy and will merit its support in its Report.

62. All of which is respectfully submitted,



Mark Stein, Eng.
President



S.D.C. Chutter,
General Manager

Appendix "A"

CONSTITUTION

CANADIAN CONSTRUCTION
ASSOCIATION

*(Incorporated under Dominion Charter granted
September 18, 1919, and by Supplementary
Letters Patent February 10, 1928
and December 6, 1963)*

■
NAME

This organization shall be known as the "Canadian Construction Association", hereafter referred to as the "Association". The French appellation of the Association shall be "L'Association Canadienne de la Construction".

■
PURPOSE

The object of the Association shall be:—(a) to promote better relations between its Members and Owners, Architects and Engineers; (b) to establish and maintain methods of practice between members within the industry; (c) to acquire and disseminate useful information concerning the industry; (d) to extend construction and improve conditions in the combined industries; (e) to co-ordinate the units of the industry in its producing, manufacturing, distributing, professional and constructive activities, thereby increasing its efficiency and extending its usefulness.

APPENDIX "B"

MEMBER ASSOCIATIONS OF THE CANADIAN CONSTRUCTION ASSOCIATION AND

LOCATIONS OF THEIR HEADQUARTERS

Newfoundland

- | | |
|------------|---|
| St. John's | Newfoundland & Labrador Construction Association Newfoundland & Labrador Road Builders Association |
|------------|---|

Nova Scotia

- | | |
|---------|---|
| Halifax | Construction Association of Nova Scotia Nova Scotia Road Builders' Association |
| Sydney | Cape Breton Island Construction Association |

Prince Edward Island

- | | |
|---------------|---|
| Charlottetown | Prince Edward Island Construction Association |
| Summerside | Prince Edward Island Road Builders' Association |

New Brunswick

- | | |
|-------------|---|
| Bathurst | Northeastern (N.B.) Construction Association |
| Edmundston | Edmundston Construction Association |
| Fredericton | Fredericton Construction Association New Brunswick Construction Association Road Builders' Association of New Brunswick |
| Moncton | Moncton Construction Association |
| Saint John | Saint John Construction Association |

Québec

- | | |
|---------------|---|
| Chicoutimi | Association des Constructeurs Saguenay-Lac St. Jean |
| Drummondville | L'Association Patronale des Constructeurs du Diocèse de Nicolet |
| Granby | L'Association des Entrepreneurs en Construction de Brôme-Missisquoi-Shefford |
| Hull | Association des Constructeurs du District de Hull et de L'Ouest du Québec |
| Montreal | Canadian Institute of Plumbing & Heating Canadian Roofing Contractors' Association Corporation of Master Electricians of Quebec Montreal Construction Association Quebec Concrete Association |

Special Committee

| | |
|----------------|--|
| Noranda | Western Québec Construction Association |
| Québec | Association de la Construction de Québec La Fédération de la Construction du Québec Québec Road Builders' and Heavy Construction Association |
| St-Hyacinthe | L'Association des Constructeurs St-Hyacinthe |
| Sherbrooke | L'Association des Constructeurs des Cantons de l'Est |
| Trois Rivières | L'Association des Constructeurs de la Mauricie Inc. |

Ontario

| | |
|------------------|---|
| Barrie | Barrie Builders' Exchange Service |
| Belleville | Quinte Construction Association |
| Chatham | Chatham Builders' Exchange |
| Fort William | Lakehead Builders' Exchange |
| Guelph | Guelph Construction Association |
| Hamilton | Hamilton Construction Association |
| Kingston | Kingston Builders' Exchange |
| Kitchener | Kitchener-Waterloo Construction Association |
| Leamington | Builders' Exchange of Leamington |
| Lindsay | Lindsay and District Construction Association |
| London | London & District Construction Association |
| Orillia | Orillia District Builders' Exchange |
| Oshawa | Oshawa & District Construction Exchange |
| Ottawa | Canadian Association of Equipment Distributors Canadian Builders' Supply Association Ottawa Construction Association Portland Cement Association |
| Peterborough | Peterborough District Construction Exchange |
| St. Catharines | Niagara Construction Association |
| St. Thomas | St. Thomas & Elgin Builders' Exchange |
| Sarnia | Sarnia Construction Association |
| Sault Ste. Marie | Sault Ste. Marie Builders' Exchange |
| Sudbury | Sudbury Construction Association |

Toronto

Aggregate Producers Association of Ontario
 Canadian Automatic Sprinkler Association
 Canadian Glass Federation
 Canadian Institute of Steel Construction
 Canadian Painting & Decorating Contractors Association
 Canadian Plumbing & Mechanical Contractors Association
 Canadian Prestressed Concrete Institute
 Canadian Sheet Steel Building Institute
 Canadian Structural Clay Association
 Construction Industry Credit Bureau, CCMA
 Electrical Contractors Association of Ontario
 Mechanical Contractors Association of Toronto
 Metropolitan Toronto Sewer & Watermain Contractors Association
 National Concrete Producers Association
 Ontario Federation of Construction Associations
 Ontario General Contractors' Association
 Ontario Refrigeration & Air Conditioning Contractors Association
 Ontario Road Builders' Association
 Ready-Mixed Concrete Association of Ontario
 Terrazzo, Tile & Marble Association of Canada
 Thermal Insulation Association of Canada
 The Insurance Bureau of Canada
 Toronto Construction Association
 Toronto & District Excavators Association

Windsor

Windsor Construction Association

Manitoba

Brandon

Brandon Builders' Exchange

Winnipeg

Manitoba Concrete Producers Association
 Roadbuilders & Heavy Construction Association of Manitoba
 Winnipeg Builders' Exchange

Saskatchewan

Moose Jaw

Moose Jaw Construction Association

Special Committee

| | |
|---------------|---|
| Prince Albert | Prince Albert Construction Association |
| Regina | Prairie Road Builders' Association |
| | Regina Construction Association |
| | Road Builders & Heavy Construction Association of Saskatchewan |
| | Saskatchewan Construction Association |
| Saskatoon | Saskatoon Construction Association |
| Swift Current | Swift Current Construction Association |

Alberta

| | |
|----------------|---|
| Calgary | Calgary Construction Association |
| Edmonton | Alberta Construction Association |
| | Alberta Road Builders' Association |
| | Edmonton Construction Association |
| Grande Prairie | Grande Prairie Construction Association |
| Lethbridge | Lethbridge Construction Association |
| Lloydminster | Lloydminster Construction Association |
| Medicine Hat | Medicine Hat Construction Association |
| Peace River | Peace River Construction Association |
| Red Deer | Red Deer Construction Association |

British Columbia

| | |
|---------------|---|
| Dawson Creek | Dawson Creek - Fort St. John Construction Associations |
| Kamloops | Southern Interior Construction Association |
| Prince George | Prince George Construction Association |
| Vancouver | Amalgamated Construction Association of British Columbia |
| | B.C. Federation of Construction Associations |
| | British Columbia Road Builders Association |
| | Electrical Contractors Association of British Columbia |
| | Master Sheet Metal & Roofing Contractors Association of B.C. |
| | Pipeline Contractors Association of Canada |
| Victoria | Amalgamated Construction Association of British Columbia - Victoria Branch |

Yukon Territory

| | |
|------------|---|
| Whitehorse | Yukon Builders' Exchange & Construction Association |
|------------|---|

APPENDIX 130



CANADIAN INSTITUTE OF STEEL CONSTRUCTION

1815 Yonge Street, Toronto 7, Ontario

**Brief to the
Special Senate Committee
on
Science Policy**

April 1969



CANADIAN INSTITUTE OF STEEL CONSTRUCTION

National Organization Representing the Structural Steel and Plate Fabricating Industries

1815 Yonge Street, Toronto 7, Ontario - Telephone 487-2158

BRIEF TO THE SPECIAL COMMITTEE ON SCIENCE POLICY OF THE SENATE OF CANADA, APRIL 30, 1969

SUMMARY

This brief is mainly limited to activities relevant to the Canadian Institute of Steel Construction and its member companies. Some views on National Science Policy proposals are also included.

Traditional construction contract relationships and the separation of the design function from the fabricators reduce the ability of steel fabricators to participate in development work. Of necessity our technology base is mainly imported.

C.I.S.C. Activities

We support a \$40,000 /year university research grants program jointly with the Canadian Steel Industries Construction Council. The C.S.I.C.C. supports the Steel Industry Fellow at the National Research Council Fire Research Station. C.I.S.C. staff are active on national technical bodies and in the dissemination of technical information.

Existing Federal Government Programs

We have no direct interest in most NRC intramural programs except the Division of Building Research, in particular the Fire Research Station and the National Building Code.

We recommend that the "users" of research (industry, consultants, other professionals) should be represented on NRC University Research Grant Selection Committees, and that the value of projects in meeting economic or social goals should be given more weight in selection.

We recommend that eligibility rules for IRAP (NRC), PAIT (Department of Industry), and IRDIA (Department of Industry) grants be made more flexible to meet the development priorities of different industries. The present rules favour laboratory research and proprietary product development but apparently exclude much applied work on manufacturing techniques and productivity improvement.

We recommend that the IRDIA tax incentive should be 25% of all eligible expenditures rather than 25% of the increase over the previous five-year average.

We recommend that the PAIT repayment requirement be revised in order to reward success as well as subsidizing the risk of failure.

National Science Policy for Canada

We accept the concept of a National Science Policy co-ordinating Federal programs with national goals, and the concept of major mission-oriented programs directed toward these goals.

International exchange of technology is essential: in many fields there is more economic value in applying the best foreign work to our own situation than in doing original work of limited application.

We believe there should be more emphasis on "development" in Canada (relative to basic research) and that a higher proportion of work should be done by industry.

The allocation of resources between research supporting economic growth and research supporting social objectives must be made at the highest level.

Cost/benefit comparisons should be used to determine the priority of competing programs and the priority of projects within programs.

In establishing research priorities it should be recognized that economic growth provides the tax base which supports social measures.

We suggest an increase in the proportion of industry representation on the Science Council and the National Research Council.

We support the proposals of the Science Council on the role of the Federal Government in major programs. With regard to the role of industry, we suggest more consultation and co-ordination between government agencies and industry on requirements and priorities.

Of the six National Goals proposed by the Science Council, we emphasize that "National Prosperity" is the basis of support for the other five. We believe that cost/benefit analysis should be used to determine the actual order of priority of their "Specific Areas for Action".



CANADIAN INSTITUTE OF STEEL CONSTRUCTION

National Organization Representing the Structural Steel and Plate Fabricating Industries

1815 Yonge Street, Toronto 7, Ontario - Telephone 487-2158

BRIEF TO THE SENATE OF CANADA SPECIAL COMMITTEE ON SCIENCE POLICY

1. INTRODUCTION

1.1 Scope

Science, engineering, and technology affect every aspect of modern society. The manner in which they are applied influences economic growth and development and also may contribute to improving the quality of life.

This brief is mainly limited to scientific and engineering activities of direct relevance to the Canadian Institute of Steel Construction and its member companies, including;

1. Description of our own activities, and
2. Comments on certain existing Federal Government research and development programs.

In addition we have included some views on the proposals for a National Science Policy for Canada.

1.2 The Canadian Institute of Steel Construction

The Canadian Institute of Steel Construction is the national organization representing the structural steel and plate fabricating industries. Its seventy-one fabricator members produce 80-85% of the industry output. Four primary steel mills are associate members. Appendix "A" gives further information on organization and objectives of the Institute.

Information on the Canadian Steel Industries Construction Council, with which the Canadian Institute of Steel Construction is closely associated on research and development matters, is also included in Appendix "A".

1.3 The Steel Fabricating Industry

Our industry includes Dominion Bureau of Statistics' classifications "Fabricated Structural Metal Industry" in total and "Boiler and Plate Work Industry" in part. While the fabrication of structural and plate steel is the principal activity, most companies also engage in related activities such as heavy machinery manufacturing, production of castings, and wholesaling of steel to other users.

Activity, which depends on the capital expenditure programs of industry, commerce, and governments, is cyclical. Industry shipments were valued at \$554,000,000 in 1966 but fell to \$485,000,000 in 1967. In 1966 these shipments were equal to nearly 8% of expenditures for non-residential construction; with on-site construction labour excluded, the value of shipments equalled nearly 16% of the value of material in Canada's non-residential construction programme.

Our industry, which serves the Canadian market almost entirely, remains highly decentralized, due to both freight and local service considerations. Imports have been a minor factor in the total picture, although recently there has been some foreign competition for major projects, particularly near tide water. There is significant foreign competition for transmission tower work. Canadian companies have had some success in exporting to nearby United States areas. These exports may increase if non-tariff barriers are overcome.

The industry is very largely Canadian owned and controlled, although a few companies have American or other foreign ownership.

The following characteristics of our environment affect our ability to participate in scientific and engineering development:

1. We fabricate custom products complying with engineering designs and specifications developed to meet an owner's particular requirements.
2. In general, this product design function is separated from the fabricating industry, in the hands of consulting engineers, architects, or owners' staff. Industry's product design scope is usually limited to details.
3. Traditional construction bidding practices and bidding documents discourage significant product design innovations by fabricators at time of bidding. Patented or proprietary systems are discouraged. Once their project design is complete, owners and their consultants can rarely consider major design changes, due to schedule and contractual commitments.
4. The system of estimating and bidding such projects leads to intense competition based mainly or entirely on price. Particularly in public tender work, there is no premium paid for technical competence above the minimum.

The above comments apply to the majority of our production. However, the fabricator is responsible for the design of standardized joists, pre-engineered buildings, some transmission towers, some platework, and certain "design-and-build" or "system building" contracts.

Separation of design and productive functions are a commonplace of the construction industry; but few other capital-intensive industries have so little control of product design or markets.

These factors severely limit the ability of our individual companies to support scientific or engineering research and development oriented toward product design with reasonable prospect of financial return. Structural fabricating companies tend to direct their applied research and development efforts toward improved fabricating and site erection methods, which affect ability to compete directly. Basic and applied research on the design of steel structures has been supported mainly by public bodies, universities, industry associations, and steel mills.

5. The cyclical nature of the industry seriously affects its members' financial resources in periods of low activity, thus limiting their ability to assure the provision of research funds on a continuing basis.

1.4 Technological Basis of the Industry

Structural steel design is based on structural engineering (branch of civil engineering) and applied mechanics. The most significant structural steel research, on which basic design rules are based, is done outside Canada particularly at Lehigh University, University of Illinois and Cambridge, among others. Canadian structural steel research has been directed mainly toward special problems. Structural steel design usually complies with Canadian Standards Association specifications, although American specifications are used for some projects.

Platwork design is based on mechanical engineering and applied mechanics. We are almost completely dependent on American research, and American specifications are used for major work.

Fabricating methods are based on metallurgy, welding technology, and manufacturing engineering (including industrial engineering) in the broad sense. Welding technology depends mainly on American research and development plus important British, Russian, and Japanese contributions, with rather limited work in Canada.

We expect that development in the above disciplines will be evolutionary rather than revolutionary except for welding technology which is changing quite rapidly.

2. TECHNICAL ACTIVITIES OF THE CANADIAN INSTITUTE OF STEEL CONSTRUCTION

2.1 University Research Programme

Through its membership in the Canadian Steel Industries Construction Council, the Canadian Institute of Steel Construction supports a program of grants for post-graduate research at the universities. The Council's present annual research budget is \$40,000 which permits support of six or seven applied research projects each year. Occasionally some funds are applied toward development studies rather than post-graduate research.

The objectives of this program are:

1. to obtain knowledge which can be applied to specific problems;
2. to assist in supporting postgraduate students interested in steel structures research;
3. to assist academic staff in sustaining an interest in steel structures research;
4. to support the presence of steel structures projects in the laboratories where undergraduate engineers are trained.

A list of the projects supported since 1962 is included as Appendix "B".

2.1.1 Method of Project Selection

The program is supervised by the Engineering and Research Committee of the Canadian Steel Industries Construction Council. The committee comprises 21 engineers representing fabricators, steel mills, and staff of the Institutes.

To ensure that projects supported are of current technical importance to industry, it has been found desirable to present a list of suggested topics to the universities as part of the following annual procedure:

1. Project suggestions are solicited from Committee Membership.
2. After some preliminary screening (e.g. duplication of work in U.S.A. or elsewhere) these topics are ranked in apparent priority to the industry by Committee vote.
3. In January or February an announcement is sent to the universities soliciting research proposals (see Appendix "C"). Our priority list is included but other topics may be submitted by the universities.
4. The Committee considers the contents of the proposal and the experience of the researcher as well as the priority of the project in making the final selection. We are able to support about one-third of the proposals received.

We encourage the unrestricted publication of these results in every way possible.

To date we have no formal method of evaluating projects after completion.

2.2 Fire Protection Research

The Canadian Steel Industries Construction Council has supported a Fire Research Fellow at the Fire Research Section, Division of Building Research, National Research Council, on a full-time basis from 1964 to 1967 and on a part time basis since 1968.

2.3 C.I.S.C. Staff Activities

The President of the C.I.S.C. is a member of the Advisory Committee on Building Research of the National Research Council.

A senior staff member serves on the Associate Committee on the National Building Code, National Research Council. Staff members and member company representatives serve on the various advisory groups and revision committees for the National Building Code.

C.I.S.C. staff members make a major contribution to the development of the Canadian Standards Association standards relevant to our industry, and many member company representatives also serve on committees.

As noted above steel structures and platework are designed in hundreds of design offices across the country, most of which are concerned with a broader range of engineering. A major concern of our head office staff and eight regional engineers is to try to ensure that the latest technical information and developments, on both steel and related matters such as fire protection and corrosion protection, are available to all interested professionals. This is accomplished through publications, library service, and personal contact.

2.4 Member Company Activities

Many companies do work of an "applied research" or "development" nature (in our definition, if not that of a pure scientist!) resulting from particular contract or production requirements, using regular staff and facilities. One company is undertaking research in welding technology with full-time research staff under a N.R.C. grant.

3. EXISTING FEDERAL GOVERNMENT RESEARCH AND DEVELOPMENT PROGRAMS

3.1 National Research Council

3.1.1 N.R.C. Intramural Projects (other than Building Research)

Our industry is not directly interested in the projects of the eleven divisions oriented toward biology, chemistry, physics, mechanical engineering, and aerospace. The N.R.C. wind tunnel has been used by consulting engineers and others interested in wind forces on structures from time to time.

3.1.2 N.R.C. Division of Building Research

The activities of the Division of Building Research are oriented toward the entire construction industry of Canada. By policy (1) this Division concentrates on problems that must be studied in this country, and does not duplicate work being carried on elsewhere. As a result they do not do work on structural performance of steel as such, since this is available from other sources as noted above.

The Steel Industry Fellow has done important basic work on fire resistance and fire protection of steel within the Fire Research Section. To date practical applications have lagged behind this basic work.

To the extent that our members may become involved with a wider range of building elements in future, possibly through participation in industrialized building systems, a broader portion of the Division's work might become of interest.

3.1.2.1 National Building Code

The National Building Code, supported by the Division of Building Research, is of inestimable value to construction in Canada. Departures from this Code by certain major cities are a continuing problem for our industry.

3.1.3 N.R.C. Support of University Research

This program has grown from \$4.6 million in 1958/59 to \$45.8 million in 1967/68 (3). The basic objectives are training of research manpower and the acquisition of new scientific knowledge (4). "Council has traditionally placed more emphasis on supporting the gifted individual than on supporting the project, department, or institution" (5).

The distribution of these funds has been: (6)

| | <u>1958-59</u> | <u>1967-68</u> |
|-----------------------------|----------------|----------------|
| Biology, Chemistry, Physics | 83% | 54% |
| Engineering | 11% | 21% |
| Other | 6% | 25% |
| | <u>100%</u> | <u>100%</u> |

- (1) "The Division of Building Research", N.R.C. No. 4879, page 5.
- (2) "Building Research 1967" N.R.C. No. 10270, pages 19, 52, 60, 72.
- (3) "N.R.C. Report of the President" N.R.C. No. 10158, pages 70 and 72.
- (4) "N.R.C. Brief to the Senate Special Committee on Science Policy" page 90.
- (5) "N.R.C. Brief to the Senate Special Committee on Science Policy" page 91.
- (6) "N.R.C. Report of the President" N.R.C. No. 10158, page 76.

We are not aware of all the criteria determining this overall allocation. If it is accepted that in Canada applied research and development have lagged behind basic research, we suggest that support of the "Engineering" sector of university research should be growing faster to provide a better balance.

We understand that the Grant Selection Committees are composed entirely of academic representatives.(7) In view of the large amount of public funds now involved, we suggest that the "users" of research results (industry, consultants, or other professionals, depending on discipline) should have equal representation with academics on the selection committees.

We believe that the value of projects in meeting economic or social goals should be given much more weight in selection. A layman may question whether a highly fragmented effort based on individual programs (including, for example, sea urchins, goldfish, vocal communication of birds, bats, turtles, and squirrels (8)) is the best use of tax resources. There is probably a minimum level of "Little Science" projects necessary to retain university staff in disciplines other than the major research interests of the institution. (For example, every Civil Engineering department must retain staff to teach structural analysis to undergraduates; at the research levels it might be preferable for universities to agree among themselves to choose different research subjects in which to specialize. Thus more might specialize in structures and hydraulics, others in soil mechanics and highways, etc. Funds beyond this level could be used to encourage rationalization and specialization in priority areas of economic or social importance. The present system appears to encourage the proliferation of unrelated projects.

This should not infringe academic freedom or university autonomy, since individuals and institutions would remain free to pursue any research which can be supported. We believe, there is a responsibility to use government tax support for projects of optimum economic or social value.

In terms of our narrow interests, the imbalance (9) between structural concrete and structural steel projects receiving NRC support is of concern to our industry.

3.1.4 NRC Industrial Research Assistance Program (IRAP)

This program, which provides for support of full-time research personnel by NRC with all other costs paid by industry, has grown from \$1.2 million in 1962/63 to \$6.1 million in 1968/69 (10). Of 177 projects active in 1968/69, only one was from a C.I.S.C. member (11). Chemical, pharmaceutical, paper, and electrical industries were the major participants, while metal fabricating, textiles, and transportation equipment had the lowest participation (12) -- that is, industries with high technological content and existing research facilities were best able to take advantage of the program, while less sophisticated industries of comparable importance to the economy had minimum participation.

The steel fabricating industry has particular problems in justifying product-oriented research due to our lack of patent or proprietary products as described in section 1.3 of this brief.

To provide a more equal opportunity for participation by our type of industry in the type of "applied research" most appropriate to our needs, we suggest that the eligibility be expanded to include research on fabricating methods and method improvement directed toward increased productivity.

- (7) "N.R.C. Brief to the Senate Special Committee on Science Policy" page 91.
- (8) "N.R.C. Annual Report on Support of University Research 1967-68" N.R.C. No. 10238 pages 49, 56, 58, 62 and 65.
- (9) "N.R.C. Annual Report on Support of University Research 1967-68" N.R.C. No. 10238 pages 187 to 195.
- (10) "N.R.C. Brief to Senate Special Committee on Science Policy" page 171.
- (11) "N.R.C. Brief to Senate Special Committee on Science Policy" page 3346.
- (12) "N.R.C. Brief to Senate Special Committee on Science Policy" page 172.

It should also be recognized that in many cases the application in Canada of existing basic knowledge must take precedence over the discovery of new knowledge. As the existence of the Industrial Engineering Section (13) of the NRC Technical Information Service recognizes the value of such work, it seems logical that IRAP should cover such projects.

3.2 Defense Research Board

The breadth of defense research in United States has resulted in considerable "fallout" of technical information of significance to our industry in metallurgy and welding technology.

Due to the special objectives of Canada's Defense Research Board and their need to specialize (14), there appears to be little common area between our industry and Canadian defense research. As far as we are aware our member companies have not applied for Defense Industrial Research grants.

The policy of having industry and other representation, in addition to academic members, on University Grants Advisory Committees (15), appears most desirable.

3.3 Department of Energy, Mines, and Resources

The Welding Section, Physical Metallurgy Division, Mines Branch, Department of Energy, Mines, and Resources, conducts a research program and special investigations in an area of direct interest to steel fabricators (16).

There is not enough awareness of the work of this Division within the fabricating industry. Since the main orientation of the Branch is toward the extractive and primary sectors, there may be uncertainty as to the extent of service available to fabricators.

3.4 Atomic Energy of Canada Limited

Several of our member firms have received contracts to fabricate structures, sophisticated platework, and other specialized equipment for atomic power stations designed by AECL. A few have received development contracts.

AECL policy in placing certain research and development contracts with industry (17) benefits both parties. Any possible increase in the proportion of "hardware" development work placed with industry would increase our capabilities in producing this class of work.

3.5 Department of Industry

3.5.1 Program for the Advancement of Industrial Technology (PAIT)

This program offers to underwrite up to 50% of the approved costs of a commercially feasible product or process development project. If commercially successful, the Department contribution must be repaid with interest. (18)

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- (13) "N.R.C. Brief to Senate Special Committee on Science Policy" pages 107 and 108.
 - (14) "Proceedings of the Special Committee on Science Policy No. 4" page 282.
 - (15) "Proceedings of the Special Committee on Science Policy No. 4" page 417.
 - (16) "Publications and Reports of the Welding Section" P.M.D. Report PM-I-67-3 Mines Branch, Department of Energy, Mines, and Resources.
 - (17) "AECL Brief to the Senate Special Committee on Science Policy" pages 717, 718, 736 and 737.
 - (18) "PAIT" brochure, Department of Industry, Id 31-1766.

To date none of our member companies has had a PAIT project approved.

We believe that the lack of PAIT participation by the steel fabricating industry is due to:

1. Lack of proprietary products in our major structural and plate-work lines as noted in Section 1.3.
2. Requirement for "significant technical advance" and similar criteria are not easily met in a mature industry where progress is evolutionary.
3. We understand that "process" development generally would not include changes in our fabricating processes (unless revolutionary).
4. If a project is successful, repayment means that the Department is merely acting as banker rather than providing a subsidy.

Changes which might make this program more attractive to structural and platework are:

1. Interpret "significant technical advance" in terms of what is possible for the industry.
2. Interpret "process" to include fabricating processes.
3. Revise (or eliminate) repayment requirement in order to reward success rather than subsidizing the risk of failure only.

3.5.2 Industrial Research and Development Incentives Act (IRDIA)

This act permits tax abatements (or grants) of 25% of approved capital expenditures and 25% of the increase of "eligible current expenditures" over the preceding five-year average.

We believe that relatively few applications under the act have been made by our member companies.

The regulations re capital expenditures for scientific research and development are relatively clear.

In our view the regulations on "eligible current expenditures" present the following problems:

1. Much more accounting work is required in preparing submissions (19) and separating eligible from ineligible elements of a company's internal costing system, than was the case with the previous program under Section 72A of the Income Tax Act.
2. As the grant is allowed on the increase in eligible expenditures only, in time it will be necessary to prepare submissions on a large total program to receive a grant on the increment.
3. The payment of grants on the increase only does not recognize the problems of companies in cyclical industries. In years of reduced commercial activity it may be a problem to sustain even a constant level of research and development -- yet in such years the grant would be cut off.
4. In distinguishing between "development" (eligible) and "production" (ineligible), "If the product or process is substantially "set" and the primary objective is to or to get the production process going smoothly or to increase output, then the work is no longer development" (20). We suggest that for some industries research and development to increase output of an existing process may be of greater economic importance than work on a new or novel process.

(19) "Instructions for Making an Application for a Grant Under IRDIA", Department of Industry.

(20) "Instructions for Making an Application for a Grant Under IRDIA", Department of Industry, page 6.

If the government wishes to encourage a more intense research and development effort by all sectors of Canadian industry, we suggest:

1. The tax abatement (or grant) should be 25% of all eligible research and development expenditures, not 25% of the increase.
2. The interpretation of "development" should be expanded to cover the needs of industries where progress is by evolution rather than novel developments, and where the priority need is application of existing technology.

We believe that the "Recommendations of the Economic Council to the Government of Canada -- March 1965" (21) would provide stronger incentives to industry. We support the comments of Mr. M. W. Mackenzie to the Senate Special Committee on this subject (22).

4. A NATIONAL SCIENCE POLICY FOR CANADA

The views expressed in this section represent considered opinions on current proposals for a National Science Policy for Canada. We do not have the resources to produce statistical evidence in support of these views.

4.1 General

- 4.1.1 We recognize the need for a National Science Policy to co-ordinate Federal scientific programs, Federal support of science in universities and industry, and guidelines for the determination and realization of national goals through the application of science, engineering, and technology.
 - 4.1.2 We assume that the right of individuals, industry, universities, Provincial and other agencies to pursue their own goals in projects not supported by Federal funds is unquestioned, although in practice many of these would co-ordinate their efforts with a strong national program.
 - 4.1.3 We accept the concept of major mission-oriented programs directed toward national economic or social goals, as the vehicles for most new Federally-supported scientific undertakings. This should permit Canada to achieve excellence (or even world leadership) in a limited number of fields instead of dissipating effort in too many directions.
 - 4.1.4 Under such a policy many industries would continue to import their technology for competitive reasons or because they are not on the main stream of the major government programs.
 - 4.1.5 International exchange of technology is essential to modern industry. It is in the interests of Canada that each Canadian industry should utilize the best technology in its field, whatever its origin. In many fields there is more economic value in applying the best work from foreign "centres of excellence" to one's own situation than in doing minor original projects. Increasing productivity through the application of existing knowledge may contribute more to economic growth than original research on subjects of limited application.
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- (21) "A General Incentive Programme to Encourage Research and Development in Canadian Industry" Report to the Economic Council of Canada by the Advisory Committee on Industrial Research and Technology. Catalogue EC22-565 pages 12 to 20.
- (22) "Proceedings of the Special Committee on Science Policy" No. 1, pages 2, 3 and 5.

4.2 Research and Development Expenditures

On the basis of figures prepared for the Science Council of Canada (23)(24), also somewhat conflicting summaries in press (25)(26) we believe:

- 4.2.1 There is too little emphasis on "development" in Canada (37% vs 66% (23) or 38% vs 78% (25) compared to U.S.) relative to "basic research" and "applied research". We agree with the Science Council that "In the past there has been a tendency to fail to carry work through from research and development to production and use". (24, page 4). We suggest that some university and government basic research does not contribute to the economy because it is not closely related to goods and services produced in Canada. More "development" work is needed to balance the Canadian R & D effort.
- 4.2.2 Too little of Canada's R&D effort is performed in industry (39% vs 70% in U.S.A.) By contrast Canada has 25% in Universities vs 13% in U.S.A. (25).
- 4.2.3 Although total Canadian R & D spending is only 1.2% of GNP compared to 3.0% in U.S.A., much of the latter is due to military requirements and the expenditures of large international corporations. We expect that a realistic target for Canada in the immediate future would be much lower.

4.3 Establishment of Priorities

- 4.3.1 As many disciplines of physical, life, and human sciences compete for financial support, we believe that the Treasury Board's (27) distinction between programs which support economic objectives and programs which support social objectives will become more important. The broad allocation of resources between research which supports economic growth and research which supports social objectives is a "political" one in the highest sense of the word which can not be determined by scientists and economists alone.
 - 4.3.2 The Treasury Board's procedure for allocation of resources (27) appears a most logical method of assigning priority to competing research programs. We believe it should be possible to develop ways of assigning "value" to basic research or health research to permit cost-benefit comparisons on the same basis as development work.
 - 4.3.3 The method of allocation between R & D supporting economic growth and that supporting social objectives should consider that economic growth provides the tax base which supports social measures.
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- (23) "Background Studies in Science Policy", Science Council of Canada Special Study No. 6 Catalogue No. SS21-1/6 page 40.
 - (24) "Towards a National Science Policy for Canada", Science Council of Canada Report No. 4 page 21.
 - (25) "Canada Asks Industry into the Lab", Business Week, December 28, 1968 page 84.
 - (26) "Federal Cash May Help Fuel More R & D in Industry" Financial Post March 1, 1969, page 13.
 - (27) "Treasury Board Brief to the Senate Special Committee on Science Policy" pages 3744.

4.4 Advisory Bodies

4.4.1 The relative responsibilities of:

The Privy Council Committee on Scientific and Industrial Research
 The Senate Special Committee on Science Policy
 The Science Council of Canada
 The Science Secretariat
 The Economic Council of Canada
 The National Research Council
 Other Crown Corporations with research functions
 Departments with research functions,

in advising on, deciding, and executing "National Science Policy"
 are not clear to the public at this time.

4.4.2 The membership of the Science Council appears to be; (28)

| | |
|-------------|-----------|
| Academic | 11 |
| Government | 6 |
| Industry | 6 |
| Consultants | 2 |
| | <u>25</u> |

If it is believed that the industrial participation in research and development should increase in future, it might be appropriate to increase the proportion of Industry representation on the Council.

4.4.3 The membership of the National Research Council in 1968 was: (29)

| | |
|--------------|-----------|
| Academic | 11 |
| NRC Officers | 3 |
| Industry | 3 |
| Medical | 1 |
| Consultant | 1 |
| Labour | 1 |
| | <u>20</u> |

We suggest that a higher proportion of industry representation would be appropriate, particularly if it is thought that the level of NRC support of industrial research will approach that of University and in-house programs.

(We have previously suggested that industry or other "users" be represented on NRC University Grants Selection Committees.)

4.5 The Role of Government

4.5.1 We support the suggestions of the Science Council for mission-oriented major programs in which "the role of the Federal Government is predominantly that of initiator, co-ordinator, and provider of funds for much of the research and development, while other sectors will be mainly performers of research and innovators".

4.5.2 We support the recommendations of the Science Council on pages 24 to 27 of "Towards a National Science Policy for Canada" regarding Federal Government support for industrial research and the role of Federal agencies.

-
- (28) "Science Council of Canada Brief to the Senate Special Committee on Science Policy" page 1005
 (29) "N.R.C. Report of the President 1967-68" N.R.C. No. 10158 page 86

4.6 The Role of Industry

- 4.6.1 We would welcome greater consultation and co-ordination between government agencies and industry on requirements and priorities.
- 4.6.2 We suggest a gradual increase in the proportion of government research and development contracted to industry.
- 4.6.3 We would welcome stronger programs to support industrial research and development, sufficiently flexible to meet the needs of metal fabricating as well as highly technological industries.

4.7 National Goals and Areas For Action

- 4.7.1 Of the six "National Goals" proposed in Section 3 of "Towards a National Science Policy for Canada" (24), Goal 1 "National Prosperity" provides the tax base which supports the other five which are more or less of a social nature. This must be considered in determining the allocation of financial support.
- 4.7.2 While we have no objections to the individual "Specific Areas for Action" in Section 7 of "Towards a National Science Policy for Canada", we suggest that each must be subjected to fairly rigorous cost/benefit analysis to determine economic or social priorities. Intuitively we question whether the proposed Space Agency should take precedence over more down-to-earth national problems and national opportunities.

THE CANADIAN INSTITUTE OF STEEL CONSTRUCTION

(Organization and Research Interests)

The CISC is the national trade association representing the structural steel, steel joist and plate fabricating industries of Canada. Employment is annually over 15,000 persons and sales volume has exceeded \$500 million. A list of members is appended hereto.

The CISC was formed in 1930 and was granted a Federal Charter as a non-profit trade association in 1942. Under its by-laws the major objective of the Institute is its concern with "Promoting greater efficiency, safety, uniform practices and economy in the use of structural steel through engineering and technical research and development directed towards new uses and improvements in design, methods, specifications, standards and codes." The by-laws also provide that this objective shall be attained by "Co-operating with and promoting co-operation among the steel mills, steel and construction associations, educational institutions, government authorities and other bodies in relation to the foregoing."

In keeping with these objectives the CISC directs a large part of its efforts to engineering development and applied research. The CISC financially supports and assists in administering grants-in-aid, fellowships and other research incentives at Canadian University and research bodies. Through staff and representatives of member companies the Institute actively participates in the work of the National Building Code of Canada, the Canadian Standards Association, the American Society for Testing and Materials and the Specification Writers Association of Canada. The Institute also supports and participates in the work of the American Research Council on Riveted and Bolted Structural Joints, the Column Research Council and the Welding Research Council.

The Institute has its head office in Toronto and regional offices in Halifax, Montreal, Toronto, Winnipeg, Edmonton and Vancouver. Its staff includes nine professional engineers.

The CISC's main research activities are through its financial support of the Canadian Steel Industries Construction Council and administrative services which it performs for the Council. The Steel Council (CSICC) has an annual budget of \$40,000 for research at Canadian Universities and also provides a Steel Industries Research Fellowship at the National Research Council. Further details of the university research are contained in appendices "B" and "C".

CANADIAN STEEL INDUSTRIES CONSTRUCTION COUNCIL

The Canadian Steel Industries Construction Council was incorporated under Federal Charter in 1965. It was preceded for five years under the name Steel Industries Advisory Council. Its members are:

The Algoma Steel Corporation, Limited
Dominion Foundries and Steel, Limited
Dunlop Steel Limited
The Steel Company of Canada, Limited
Canadian Fasteners Institute
Canadian Institute of Steel Construction
Canadian Sheet Steel Building Institute
Corrugated Steel Pipe Institute
The Canadian Welding Bureau (Associate Member).

The Steel Council's objective is to promote the manufacture, fabrication and use in the construction industry in Canada of construction steel, namely structural, plate, sheet and stainless steel and related steel products.

The Steel Council's special concern with research is emphasized by the provision in its by-laws authorizing it to promote "greater efficiency and economy in the use of construction steel through engineering and technical research directed towards improvements in design, building codes, specifications and standards."

The by-laws further provide that this objective shall be achieved by "co-operating with and promoting co-operation among educational institutions, government bodies and other authorities" in relation to such matters.



CANADIAN INSTITUTE OF STEEL CONSTRUCTION

National Organization Representing the Structural Steel and Plate Fabricating Industries

1815 Yonge Street, Toronto 7, Ontario - Telephone 487-2158

LIST OF MEMBERS

STRUCTURAL MEMBERS

Acier Ste-Rose Ltee
101 St. Francois Street
Vimont, Co. Laval, P.Q.

A I M Steel Limited
P.O. Box 655
Edmonton, Alta.

A I M Steel Limited
P.O. Box 3300
Vancouver, B.C.

Anthes Steel Products Limited
3420 Dundas Street West
Toronto, Ontario

Bomac Steel Company Limited
P.O. Box 98
Mississauga, Ontario

Bridge & Tank Company of
Canada Limited
P.O. Box 325
Hamilton, Ontario

Bridge & Tank Western Limited
Sutherland & Maple Streets
Winnipeg 2, Man.

Brittain Steel Ltd
400 Ewen Avenue
New Westminster, B.C.

Canadian Structural Steel Works
Company Limited
3700 St. Joseph Boulevard East
Montreal, P.Q.

Canam Steel Works Inc.
P.O. Box 245
Beauce, Quebec

Canron Limited
Prairie Structural Division
P.O. Box 5250, Station "A"
Calgary, Alta.

Canron Limited
Eastern Structural Division
P.O. Box 529
Dartmouth, N.S.

Canron Limited
Prairie Structural Division
P.O. Box 2298
Edmonton, Alta.

Canron Limited
160 St. Joseph Boulevard
Montreal, P.Q.

Canron Limited
Eastern Structural Division
1630 Star Top Road
Mobile Route 1
Ottawa 9, Ontario

Canron Limited
Eastern Structural Division
100 Disco Road
Rexdale, Ontario

Canron Limited
Western Bridge Division
145 West 1st Avenue
Vancouver 10, B.C.

Central Quebec Steel Limited
1005 Pere Daniel
P.O. Box 1360
Three Rivers, P.Q.

Coast Steel Fabricators Limited
7950 Venture Street
Lake City Industrial Park
Burnaby 2, B.C.

(Contd.....)

STRUCTURAL MEMBERS

Contd.

Dominion Bridge Company Limited
P.O. Box 2430
Calgary, Alta.

Dominion Bridge Company Limited
P.O. Box 400
Edmonton, Alta.

Dominion Bridge Company Limited
P.O. Box 280
Montreal, P.Q.

Dominion Bridge Company Limited
P.O. Box 1910
Regina, Sask.

Dominion Bridge Company Limited
P.O. Box 310
Terminal "A"
Toronto, Ontario

Dominion Bridge Company Limited
P.O. Box 2160
Vancouver 3, B.C.

Dominion Bridge Company Limited
P.O. Box 895
Winnipeg 1, Man.

Dominion Steel & Coal Corporation
Limited
Truscon Steel Division
P.O. Box 100, Station "S"
Montreal, P.Q.

Eastern Canada Steel & Iron
Works Limited
P.O. Box 7000
Quebec, P.Q.

Frankel Structural Steel Limited
1139 Shaw Street
Toronto 4, Ontario

Great Lakes Steel Products Ltd
P.O. Box 238
Port Arthur, Ontario

John T. Hepburn Limited
914 Dupont Street
Toronto 4, Ontario

Hawker Siddeley Canada Limited
Agents for Hawker Industries
Canadian Bridge Division
1219 Walker Road
Windsor, Ontario

Hilkron Steel Works (Canada)
Limited
5815 Dixie Road North
Mississauga, Ontario

James United Steel Limited
P.O. Box 398
Welland, Ontario

11 Racine Road
Rexdale, Ontario

La Compagnie Atlantic Ltee
95 Leonidas
Rimouski, P.Q.

Les Industries Super-Metal Inc.
655 Boulevard P. Bertrand
Quebec 8, P.Q.

London Steel Industries
48 Burslem Street
London, Ontario

Lord & Compagnie Limitee
4700 rue Iberville
Montreal, P.Q.

Louis Pickard & Co. Inc.
5585 De la Roche
Montreal 34, Quebec.

MacKinnon Structural Steel
Company Limited
3285 Cavendish Boulevard
Suite 300
Montreal, P.Q.

(Contd.....)

STRUCTURAL MEMBERS

Contd.

Maritime Steel & Foundries Ltd
New Glasgow, N.S.

Newman Structural Steel Limited
P.O. Box 310
Welland, Ontario

Niagara Structural Steel Company
Limited
P.O. Box 730
St. Catharines, Ontario

Norak Steel Construction Limited
Credit Stone Road
Concord, Ontario

Noront Steel Limited
P.O. Box 36
Sudbury, Ontario

Ocean Steel & Construction Limited
P.O. Box 187
Lancaster, N.B.

Prepost Company Limited
200 Hymus Road
Scarborough, Ontario

Robb Engineering
A Division of Dominion Bridge
Company Limited
P.O. Box 490
Amherst, N.S.

Structal Inc.
P.O. Box 400
Quebec, P.Q.

Standard Structural Steel Limited
5330 Pare Street
Montreal 9, P.Q.

The Toronto Iron Works Limited
Central Bridge Division
629 Eastern Avenue
Toronto 8, Ontario

York Steel Construction Limited
75 Ingram Drive
Toronto 15, Ontario

York Structural Steel Limited
P.O. Box 1417
Fredericton, N.B.

M. Zagerman & Co. Limited
100 Bayview Road
Ottawa, Ontario

STRUCTURAL MEMBERS

Contd.

Maritime Steel & Foundries Ltd
New Glasgow, N.S.

Newman Structural Steel Limited
P.O. Box 310
Welland, Ontario

Niagara Structural Steel Company
Limited
P.O. Box 730
St. Catharines, Ontario

Norak Steel Construction Limited
Credit Stone Road
Concord, Ontario

Noront Steel Limited
P.O. Box 36
Sudbury, Ontario

Ocean Steel & Construction Limited
P.O. Box 187
Lancaster, N.B.

Prepost Company Limited
200 Hymus Road
Scarborough, Ontario

Robb Engineering
A Division of Dominion Bridge
Company Limited
P.O. Box 490
Amherst, N.S.

Structal Inc.
P.O. Box 400
Quebec, P.Q.

Standard Structural Steel Limited
5330 Pare Street
Montreal 9, P.Q.

The Toronto Iron Works Limited
Central Bridge Division
629 Eastern Avenue
Toronto 8, Ontario

York Steel Construction Limited
75 Ingram Drive
Toronto 15, Ontario

York Structural Steel Limited
P.O. Box 1417
Fredericton, N.B.

M. Zagerman & Co. Limited
100 Bayview Road
Ottawa, Ontario

PLATEWORK MEMBERS

Allen Tank and Welding Co. Limited
750 Little Simcoe Street
London, Ontario

Amalgamated Metal Industries Ltd
Plate and Structural Steel Division
2520 Haines Road
Mississauga, Ontario

Bridge & Tank Company of Canada Limited
P.O. Box 325
Hamilton, Ontario

Canadian Erectors Limited
5441 Notre Dame West
Montreal, P.Q.

Canron Limited
Western Bridge Division
145 West 1st Avenue
Vancouver 10, B.C.

Dominion Bridge Company Limited
P.O. Box 2430
Calgary, Alta.

Dominion Bridge Company Limited
P.O. Box 280
Montreal, P.Q.

Dominion Bridge Company Limited
P.O. Box 310, Terminal "A"
Toronto, Ontario

Dominion Bridge Company Limited
P.O. Box 2160
Vancouver 3, B.C.

Foresteel Industries Limited
10705 Henri Bourassa Blvd. East
Montreal 12, P.Q.

Horton Steel Works Limited
Suite 1200
Building P.O. 12
Toronto, Ontario

Horton Steel Works Limited
40 Jennet Street
Fort Erie, Ontario

Manitoba Bridge & Engineering Works
P.O. Box 578
Winnipeg, Man.

Saskatchewan Steel Fabricators Limited
1050 St. John Street
P.O. Box 1276
Regina, Sask.

The Toronto Iron Works Limited
Plate Fabrication Division
629 Eastern Avenue
Toronto 8, Ontario

ASSOCIATE MEMBERS

The Algoma Steel Corporation Limited
Sault St. Marie, Ontario

Suite 1914
The Royal Bank of Canada Building
1 Place Ville Marie
Montreal 2, P.Q.

Royal Bank of Canada Building
20 King Street West
Toronto 1, Ontario

Bethlehem Steel Export Company of
Canada Limited
Room 903, Dominion Square Building
1010 St. Catharines Street West
Montreal, P.Q.

P.O. Box 70
Toronto Dominion Bank Tower
Toronto Dominion Centre
Toronto 1, Ontario

British Iron & Steel Corporation Limited
c/o H.M. Long Limited
2228 Walkley Avenue
Montreal 28, P.Q.

British Steel Corporation
P.O. Box 403
33 Grosvenor Place
London, S.W.1. U.K.

Burlington Steel Company
A Division of Slater Steel
Industries Limited, Postal Station "A"
P.O. Box 271
Hamilton, Ontario

Dominion Foundries and Steel Limited
P.O. Box 460
Hamilton, Ontario

Dominion Steel & Coal Corporation Ltd
P.O. Box 249
Montreal, P.Q.

Interprovincial Steel & Pipe
Corporation Limited
P.O. Box 1670
Regina, Sask.

Manitoba Rolling Mills
Room 406
428 Portage Avenue
Winnipeg 1, Man.

The Steel Company of Canada Limited
Hamilton, Ontario

525 Dominion Street
Montreal, P.Q.

United States Steel International
Limited, Suite 706
National Trust Building
7 King Street East
Toronto 1, Ontario

306-286 Smith Street
Winnipeg 1, Man.

Western Canada Steel Limited
450 S.E. Marine Drive
Vancouver 15, B.C.

4/25/69

UNIVERSITY RESEARCH PROGRAMME

Initially by direct grants and now through its membership in and financial support of the Canadian Steel Industries Construction Council, the Canadian Institute of Steel Construction has participated in a continuing programme of Canadian university research. The Steel Council (CSICC) post-graduate university research grant programme is now established at \$40,000 annually.

University research projects which the CISC and CSICC have supported since 1962 are as follows:

Completed Projects

| | | |
|-----|--|----------|
| 1. | "Variable Stress Cycle Fatigue" Ecole Polytechnique, Montreal | \$12,000 |
| 2. | "Large Openings in Beam Webs" McGill University | \$15,800 |
| 3. | "Investigation of Castellated Beams" Nova Scotia Technical College | \$ 4,800 |
| 4. | "Investigation of Open-Web Steel Joists" University of Toronto | \$ 4,800 |
| 5. | "Single Angle/Single Plate Beam Connections" University of British Columbia | \$11,400 |
| 6. | "Concentrated Loads/Orthotropic Deck" University of Calgary | \$ 4,000 |
| 7. | "Electro-Slag Welded Joints" University of Toronto | \$ 2,000 |
| 8. | "Eccentrically Loaded Bolted Connections" Nova Scotia Technical College | \$ 6,050 |
| 9. | "End Plate Beam Connections" University of Toronto | \$ 1,000 |
| 10. | "Width-Thickness Ratios/Angle Struts" University of Windsor | \$ 4,500 |

Current Projects

| | | |
|----|--|----------|
| 1. | "Fatigue of Galvanized Bolted Joints" University of Toronto | \$ 3,200 |
| 2. | "Fatigue/Welded Wide Flange" University of Waterloo | \$ 6,000 |
| 3. | "Width-Thickness Criteria/High Strength Steels" University of Alberta | \$11,950 |
| 4. | "Web Stability/Beam Column Connections" University of Waterloo | \$12,700 |
| 5. | "Elasto-Plastic Structures/Wind Action" University of Western Ontario | \$ 3,700 |

| | | |
|-----|--|----------|
| 6. | "Design Requirements/Space Structures" Université Laval | \$ 7,000 |
| 7. | "Static and Dynamic Strength/End Plates" University of Saskatchewan | \$ 3,000 |
| 8. | "Reinforced Web Openings in Beams" McGill University | \$ 2,500 |
| 9. | "Incorporating S16 in ICES-STRU DL" University of Toronto | \$ 5,200 |
| 10. | "Eccentrically Loaded Welds" Nova Scotia Technical College | \$ 6,500 |
| 11. | "Analysis of Frames" University of Manitoba | \$ 3,000 |
| 12. | "Bolted Connections for Tubular Members" Université Laval | \$ 6,500 |

New Projects

| | | |
|----|---|-----------------------|
| 1. | "Composite Design/Joists/Cellular Steel Floor" McMaster University | estimated \$ 7,000 |
| 2. | "Bracing Requirements/Drift Limits/Steel Frames" University of Western Ontario | estimated \$ 7,000 |
| 3. | "Analysis of Curved Box Girders" University of New Brunswick | estimated \$ 4,800 |
| 4. | "Beam Stresses/Reinforced Circular Holes" McGill University | estimated \$ 4,700 |
| 5. | "New Shear Connectors/Composite Design" not yet assigned | estimated \$ 6,000 |
| 6. | "Stud Welding/Low Temperatures" not yet assigned | estimated \$ 2,000 |

ANNOUNCEMENT AND PRIORITY LISTCSICC STEEL CONSTRUCTION RESEARCH GRANTS PROGRAMME1969 RESEARCH GRANTS

Members of engineering faculties of Canadian universities are invited to apply for research grants offered by the Canadian Steel Industries Construction Council (CSICC). Grants are awarded for research on subjects judged to be of value in advancing the use of steel in construction.

Awards to a total value not exceeding \$40,000. will be announced at the end of March 1969. Each grant is for a one year period and will be for an amount between \$2,000. and \$7,000. Awards are made at the discretion of CSICC, on the merit of applications received. Conditions pertaining to award of grants and some suggested research topics are appended.

Applications must be received no later than March 17, 1969, and should be submitted to:

*University Research Grants Programme
c/o Canadian Steel Industries Construction Council
1815 Yonge Street
Toronto 7, Ontario.*

CONDITIONS PERTAINING TO AWARD
OF CSICC RESEARCH GRANTS

1. Funds will be paid to the University, to be held in trust. Unless otherwise agreed upon, payment will be made in equal quarterly instalments commencing September 15, 1969.
2. Acceptance of an award constitutes a contract to undertake and complete the research project described in the application. Unless otherwise agreed upon, CSICC is not obliged to provide supplementary funds nor to donate material and/or equipment.
3. During the course of the work CSICC shall be provided with three copies of progress reports covering the first, second and third, quarters of the period in which the research is underway. Progress reports normally will be submitted January 1, April 1 and July 1, 1970.
4. Upon completion of the work CSICC shall be provided with three copies of:
 - 1) the final detailed report
 - 2) a brief, comprehensive summary of the report
 - 3) an abstract of the report
5. The recipient of a grant may prepare a paper, or papers, based on his research and submit same for publication in an appropriate engineering journal or an equivalent. Should a paper not be prepared within six months of receipt of the final report, CSICC may, at its option, request the recipient to prepare a paper suitable for publication.
6. Grants are awarded for a period of one year only. Award of grants in succeeding years for additional phases of projects begun in 1969 will be subject to approval each year. Projects intended as one phase of a larger project extending over a period of more than a year shall be so identified in the application.
7. The following information shall be included in the application:
 - 1) Name of University and relevant Faculty, Department, etc.
 - 2) Name of applicant (project director).
 - 3) Position of applicant.
 - 4) Qualifications of applicant, including brief outline of any research currently in progress or recently completed.
 - 5) Title, Scope, Purpose and Objectives of proposed research project.
 - 6) Brief description of general procedure to be followed, including, personnel, equipment, specimens, etc. likely to be required.
 - 7) Proposed time schedule.
 - 8) Funds to be provided by other sponsors, if any.
 - 9) Amount of money requested, with a brief statement of anticipated disbursements.
 - 10) A statement signifying that the conditions pertaining to award of CSICC research grants (as stated herein) are acceptable to the applicant.

SUGGESTED RESEARCH TOPICS

Suggested research topics, in order of CSICC preference are listed below. Applicants also may submit proposals for research on other topics, including additional phases of previously sponsored projects. If a subject is selected which is outside the scope of the listed topics, the applicant should indicate the need for and possible advantages of the research.

- 1) *An investigation of bracing requirements and drift limits for steel framed buildings, the object being to determine rational rules for proportioning bracing required for frame stability under gravity and lateral loads similar to those proposed for the 1970 National Building Code of Canada.*
- 2) *Analysis of box girders curved in plan. Loading conditions and box girder geometry should be selected with bridge construction in mind the object being to develop a rational, simplified analytical procedure that could be used as the basis for a design method.*
- 3) *An investigation of continuous composite beams incorporating $1\frac{1}{2}$ inch cellular steel floor units, the object being to determine the parameters affecting structural behaviour and to develop suitable design rules.*
- 4) *An investigation of economical and practical ways to develop interaction between steel and concrete in composite construction, the object being to assess alternative types of shear connector to those in current use.*
- 5) *An investigation of composite beams incorporating 3 inch cellular steel floor units, the objects being to determine the parameters affecting structural behaviour and to develop suitable design rules.*
- 6) *An investigation of beam-column moment connections having the beam flanges welded and the beam web bolted as a bearing-type high-strength bolted joint. The object is to determine the minimum web connection necessary to fully develop the beam.*

APPENDIX 131

CANADIAN TRUCKING ASSOCIATIONS INC.

SUBMISSION
TO THE
SPECIAL COMMITTEE
ON
SCIENCE POLICY
SENATE OF CANADA

MARCH, 1969

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SUMMARY AND RECOMMENDATIONS

1. Canadian Trucking Associations Inc. is a federation of seven provincial and regional Associations whose membership is made up approximately 7,000 'for-hire' and private carriers.
2. In a recent survey on the state of R & D in the 'for-hire' trucking industry, it was found that R & D expenditures were less than $\frac{1}{4}$ of 1% of the total operating revenues of the companies responding to the questionnaire. According to that survey, about 45% of the money spent was used in operational research; approximately 37% on the development of improved equipment; 15% on general economic problems of the trucking industry; and 3% on labour problems.
3. If trucking is to compete with other modes of transport, it must retain its inherent advantages. This will require a substantial increase in the amount of operational research done within the industry. Lending even greater urgency to the need for more applied research in the industry is the fact that the main competitors of Canadian trucking firms are the rail operations of the CNR and CPR, both of which undertake substantial R & D programs.
4. At the present time, steps are being taken by the national Association to increase research in the industry. The Association itself is in a state of reorganization which should permit access to larger revenues and a substantial increase in the research being done for the whole industry. Serious efforts are being made in co-operation with DBS to improve the quantity and quality of statistical information provided by the industry.
5. The following are areas where there is an immediate need for further research in matters affecting the trucking industry:
 - a) Urban Transportation -- Movement of Goods

Despite the direct relationship between the movement of people and the movement of goods in cities, urban transportation problems are generally thought of as movement of people by urban planners. This is an area where research is

necessary because it is more obvious than ever that increased efficiency in inter-city service can be more than offset by rising costs of pick-up and delivery in urban areas.

b) Tax Barriers Between Provinces Resulting in Increased Costs of Interprovincial Commerce Carried by Motor Carrier

Duplication of road user taxes imposed by the provinces add significantly to the cost of interprovincial road transport. These costs are eventually passed on to the consumer. The trucking industry suggests that an independent study should be made as to the effects of these hidden barriers to trade between the provinces and that such a study will expedite introduction of a meaningful system of tax reciprocity between the provinces.

c) Research into Inter-urban Road System to Meet Future Needs of the Economy

There is a direct relationship between highway construction and regional economic developments, as well as road safety. Considering the predicted growth rate in vehicle registration, there is obviously a need for further research into inter-urban road systems to meet the future needs of the economy. In that context, the relationship between highway construction standards and the sizes and weights of commercial vehicles is of vital concern to the trucking industry.

d) Physical Distribution Problems -- The Problem of Freight Claims and Lack of Uniformity in Packaging Standards

It is generally conceded that the field of physical distribution is wide open for applied research. A particular problem affecting all modes of transport relates to damage claims to shipments, a serious cost factor for all modes of transport. An inter-industry Committee has been established to study this problem. It is an area where co-operation in research projects between governmental agencies and the transportation industry could result in meaningful improvement in freight handling and packaging standards.

e) Acquisitions and Mergers -- Concern Over Foreign Ownership

Mergers and acquisitions in the Canadian trucking industry will increase significantly in the years ahead. The question of foreign ownership of the Canadian trucking industry requires serious examination. Under the National Transportation Act, the Canadian Transport Commission cannot refuse an acquisition on grounds of public policy simply because the acquirer is a foreign-owned subsidiary. This situation may not be in the long-run interests of Canada, and the Canadian Transport Commission should give consideration to recommending possible amendments to the National Transportation Act.

Main Recommendations

1. The federal and provincial Governments, in their respective spheres of jurisdiction, should be prepared to work closely with individual companies and associations in a joint sponsorship of research projects. Associations can play a vital role in encouraging and co-ordinating specific research projects to be undertaken by government agencies in conjunction with individual carriers. In this manner, the results of such research will be made available to the widest number of companies, thereby ensuring the maximum advantage from research expenditures.
2. The Research and Development Incentives Act specifically excludes research grants to associations and other non-profit organizations. We would recommend that the Act be amended to permit federal Government grants to associations which are in a position to carry out research projects on behalf of the industries they represent.
3. Government departments or agencies responsible for conducting transportation research should be encouraged to initiate research projects on their own, which, while of specific interest to a particular mode of transport, nevertheless, are of such general application as to contain an element of "public interest". The problem pertaining to tax barriers to

interprovincial trade as they affect interprovincial truck operations, as well as the matter of public policy on mergers and consolidations in the trucking industry, would fall into this category.

4. Due to the general scarcity of qualified research personnel in the transportation field in Canada, the federal Government should consider additional means to encourage Canadian universities in assisting industry in carrying out research projects. At the present time, there are some 375 U.S. colleges and universities offering courses and degrees in fields directly related to transportation. It is felt that one way to encourage Canadian universities to offer a comprehensive range of courses related to transportation is to support transportation research at the university level.

INTRODUCTION

Canadian Trucking Associations Inc. is a federation of seven provincial and regional Associations, namely:

Automotive Transport Association of B.C.
Alberta Motor Transport Association
Saskatchewan Trucking Association
Manitoba Trucking Association
The Automotive Transport Association of Ontario (Inc.)
Trucking Association of Quebec, Inc.
(L'Association du Camionnage du Québec, Inc.)
Maritime Motor Transport Association, Inc.

Membership of the provincial Associations is made up of approximately 7,000 'for-hire' and private carriers.

The main objectives of the national Association of the trucking industry are to promote rational legislation; to collect and disseminate information relative to the operations of the trucking industry; and, generally, to do all such things as are incidental to the attainment of these objectives.

Traditionally, CTA's role has been that of legislative watch-dog at the national level. As a result of the new national transportation policy as set out in the National Transportation Act, we anticipate that the role of the Association will change substantially. With implementation of Part III of the National Transportation Act, CTA will be called upon to provide many additional services to the trucking industry to assist individual companies to better compete with other modes of transport. At the present time, CTA is in the middle of a major structural reorganization in anticipation of the changing role that the Association will be called on to fulfil.

THE TRUCKING INDUSTRY IN GENERAL

The trucking industry in Canada has grown tremendously since World War II. Improvements in the inter-city highway system, and particularly the Trans-Canada Highway, have made it possible for trucks to serve the ever-increasing needs of the cities and towns of the Nation. The demand for trucking services has grown to the point where in 1966 'for-hire' carriers alone accounted for 1/3 of the inter-city freight revenue generated in Canada. 'For-hire' carriers account for less than 7% of the total commercial vehicle registrations in Canada.

Due to the large number of relatively small carriers which make up the Canadian trucking industry, and the great difficulty encountered in trying to obtain information on private trucking operations, there is a lack of meaningful statistical information on the industry in Canada. For this reason, precise information as to the size and rate of growth in the trucking industry must be based on projections and arbitrary comparisons with the trucking industry in the United States. It is estimated that 'for-hire' carriers are presently doing about one billion dollars of business a year. The 1961 census shows that 160,000 Canadians gave their primary occupation as truck transport driver. CTA estimates that a minimum of 400,000 Canadians are directly employed in the 'for-hire' and private motor transport industry with tens of thousands of others employed in service and related industries.

The demand for trucking services is closely related to the growth rate in the manufacturing industry, and particularly secondary manufacturing. Latest DBS figures show that exports by truck to the United States have increased from 20.2% in 1963 to 33.9% of the total value of exports in 1967. Much of the growth in exports to the U.S. in recent years can be attributed to auto parts and other manufactured goods.

In the United States, more meaningful statistical information on the trucking industry is available. In a recent

publication "American Trucking in 1980" produced by our sister Association, American Trucking Associations Inc. of Washington, D.C., some fairly sophisticated predictions have been made on the future growth rate of trucking relative to other modes, based on historical trends. In 1966, interstate 'for-hire' carriers accounted for 48.5% of the inter-city freight revenue generated annually by all modes of transport, including pipelines. This figure is expected to increase to 61.2% by 1980. (See appendix).

STATE OF RESEARCH IN THE CANADIAN TRUCKING INDUSTRY

A) RESEARCH CONDUCTED BY CARRIERS

The Canadian trucking industry is composed of many relatively small companies with only a few of the largest carriers qualifying as medium-sized Canadian corporations. While there is no doubt that the present trend towards consolidation within the industry will accelerate in the future, it is equally clear that there will continue to be a great number of relatively small carriers operating on a local basis. It has always been assumed that very little research was done within the industry, and that it was done exclusively by the larger carriers.

CTA recently assisted the Science Secretariat of the Privy Council in conducting a survey on the state of R & D among the larger Canadian 'for-hire' carriers. Of 236 firms canvassed 60 useful replies were received. While the results of the survey are inconclusive because of the relatively few reporting carriers, it is at least possible to use the results of the survey to project trends within the industry. Some of the more interesting of these results are as follows:

1) Research Expenditures as a Percentage of Gross Revenue

The survey showed that R & D expenditures run at less than 0.25% of the total operating revenue of those companies responding to the questionnaire.

2) Persons Engaged in R & D

The survey shows that there has been a tendency in recent years for more and more R & D to be turned over to outside consultants. The survey also revealed a definite tendency to up-grade the academic qualifications of those engaged in R & D work for the industry.

3) Nature of R & D Work Undertaken by the Trucking Industry

Of the R & D projects reported, about 45% of the money spent was used in operational research into such matters as fleet utilization; terminal operations; intermodal operations; management operations; and accounting systems. Approximately 37% of the expenditure of research went on the development of improved equipment including:- equipment utilization; terminal design; transfer and handling equipment; containerization; and, special handling facilities for perishable goods and bulk freight. About 15% of the research dealt with general economic conditions in the trucking industry such as marketing and freight revenues. Only 3% of the research expense reported dealt with labour problems. This last figure, however, does not take into account the work done on behalf of the industry by the provincial trucking Associations or the labour relations bureaux who represent motor carriers in labour matters.

4) Optimum Efficiency in Terms of the Number of Employees

The survey results show that there is apparently an optimum size for trucking operations in terms of earnings per employee. This figure is around the two hundred employee level since both above and below this figure, gross revenue per employee drops off significantly. This would suggest that cost-saving factors such as maximum utilization of equipment, regular and predictable levels of business and the standard aids to terminal operations can lead to definite efficiencies, but that beyond a certain size of operation, economies of scale are not easily realized in such a highly labour-intensive industry.

Special Committee**B) RESEARCH DONE AT THE ASSOCIATION LEVEL**

With the limited staff and financial resources that have been available to the national Association, such research as has been done by CTA has been largely dictated by specific problems which have arisen over the years. At the provincial Association level, where there is a close liaison with senior management in the trucking companies, a considerable amount of work has gone on over the years which might qualify under the heading of applied or operational research. In many cases, CTA and the provincial Associations have engaged the services of economic, legal or other technically qualified persons to assist in such research. A few examples of the type of work done by CTA over the years will suffice to indicate where the research efforts of the industry have been concentrated. These include:

- 1) Preparation by economic consultants of a research paper entitled, "Theories, Objectives and Practical Problems of Road Finance" for presentation to the 1956 Convention of the Canadian Good Roads Association. The paper won the President's medal for the best technical paper presented. The findings of this research paper on road finance and allocation of costs have been borne out by virtually all independent studies on the subject, the latest being the Ontario Committee on Taxation Report of 1967 (The Smith Report). After an exhaustive study of road costs and road user taxes, the Report concluded at page 275, Vol. III, that "... the owners of heavy trucks and buses are more than meeting their cost responsibility".
- 2) Preparation of the major submission on behalf of the trucking industry to the MacPherson Royal Commission on Transportation. A great deal of preparatory work and research went into this major submission.
- 3) Research into hours of work in the trucking industry pertaining to Bill C-126 -- The Canada Labour (Standards) Code. In this case the trucking industry spent tens of thousands of dollars on research into working conditions, hours of work,

etc. within the trucking industry from coast to coast, in preparing the various submissions to Government which were required in order to achieve a more realistic and flexible application of the rigid concept of standard working hours contemplated under the Code.

- 4) Economic and legal research conducted by CTA in preparing a brief on behalf of the trucking industry with regard to the Railway Costing hearings held by the Canadian Transport Commission in 1968.

RESEARCH CARRIED ON BY THE TRUCKING INDUSTRY IN THE UNITED STATES

American Trucking Associations Inc. has an annual budget in excess of \$6 million and employs some 275 persons. ATA is heavily involved in research through its different departments, be it the Department of Research and Transport Economics, Engineering Department, Industrial Relations Department or Safety Department. In addition, ATA is in a position to publish a large variety of booklets, pamphlets, bulletins, manuals, periodicals and even a newspaper, which are useful to the industry in providing a source of technical information that otherwise would not be available to carriers.

Many ATA research projects are also sponsored by, or carried out in co-operation with various segments of the industry. An example of this is a recently-released study prepared by the ATA through a grant from an equipment manufacturer entitled, "Shipper-Motor Carrier Dock Planning Manual", which is undoubtedly the most extensive study done in the field and should be of great value to carriers, shippers, architects, city planning departments and other government agencies.

Obviously, CTA will not be in a position to match this type of operation within the foreseeable future. In terms of truck registration, the Canadian industry is only about 8% as large as the trucking industry in the United States. Due in

large part to the difference in the two economies, the Canadian 'for-hire' trucking industry is proportionately much smaller than its U.S. counterpart.

PROBLEMS OF TRANSPORTATION RESEARCH IN RELATION TO OTHER MODES

If trucking is to compete with other modes of transport, it must retain the inherent advantages usually associated with this mode. This will require a substantial increase in the amount of operational research done within the industry. The problem therefore is to determine the steps that should be taken to ensure that individual carriers and the trucking Associations undertake sufficient research so that the trucking industry will remain efficient and competitive.

Lending even greater urgency to the problem of increasing operational research in the industry is the fact that the main competitors of Canadian trucking firms are the rail operations of the CNR and CPR, two gigantic corporate undertakings by any standard. The two major Canadian railways are generally considered to be leaders in most aspects of rail transport research in North America.

STEPS BEING TAKEN TO INCREASE RESEARCH WITHIN THE INDUSTRY

Reference has been made to the structural and financial reorganization presently being undertaken by CTA. Hopefully, these changes will allow us to devote a substantial part of our annual budget to research within the next few years. CTA plans to gradually add qualified personnel to its staff for this purpose. As a step in this direction, the Board of Directors recently approved a recommendation to the effect that CTA should retain a transportation economist to advise the industry on a permanent basis. It has been our experience that qualified

transportation economists in Canada are in extremely short supply.

One of the most important tools of economic research is the availability of meaningful and up-to-date statistical information. In the past, such information has been extremely hard to come by due largely to the composition of the industry. Small carriers simply do not have the time or knowledge to complete even relatively simple questionnaires. CTA has recently undertaken a campaign in co-operation with DBS to educate such "delinquent" carriers on the importance of co-operating with DBS. DBS intends to adopt a new approach to improve the flow of statistical information on the industry and hopefully these efforts will bear fruit in the near future.

The Automotive Transport Association of Ontario (Inc.); one of our oldest and largest provincial Associations, through the ATA Trucking Industry Educational Foundation, has made grants to York University totalling close to \$50,000 to explore the feasibility of broadening research and scholastic facilities in Canada for undergraduate studies and graduate research in the field of transportation. Several meetings have been held with representatives from government and various universities. As a result of this initiative, we expect that York University will set up a Centre of Transportation Studies. This initiative, we believe, deserves to be supported by all branches of the transportation industry as well as government agencies.

AREAS WHERE THERE IS AN IMMEDIATE NEED FOR FURTHER RESEARCH

1) Urban Transportation -- Movement of Goods

CTA arranged for a paper to be given on behalf of the trucking industry to the First Canadian Urban Transportation Conference held in Toronto in February, 1969. The research work for this paper was undertaken by a major Canadian carrier in co-operation with ATA of Ontario. Use was also made of some

preliminary studies carried out by a carrier in Western Canada.

The purpose behind CTA's participation was to convince this concerned and knowledgeable group that there is a direct relationship between the movement of people and the movement of goods in urban centres. We are satisfied that this point was established as a result of our participation.

The knowledge and experience gained in the preparation of our submission to the First Canadian Urban Transportation Conference will definitely lead to further research, with the benefits accruing to the entire trucking industry as well as urban planning in general. This is an area where we must press ahead because it is now more obvious than ever that increased efficiency in inter-city service can be more than offset by rising costs in the urban pick-up and delivery segment of a total movement.

2) Tax Barriers Between Provinces Resulting in Increased Costs of Interprovincial Commerce Carried by Motor Carrier

For many years the trucking industry has been urging provincial governments to introduce a meaningful system of reciprocity with regard to road user taxes for trucks engaged in extra-provincial transport. For the most part, the Canadian provinces have imposed taxes on any vehicle operating within their jurisdiction without reference to similar taxes imposed on the same vehicle in other jurisdictions. The failure of provincial governments to introduce a meaningful system of reciprocity means that trucks operating in two or more provinces often pay the full licensing fee in each province as well as sales tax in each province on the full value of equipment and repairs. In addition, there are duplications in fuel tax and workmens compensation payments.

These crippling duplications of tax add significantly to the cost of interprovincial road transport and are becoming more burdensome as the industry grows. At least a portion of such added costs are passed on to the consumer in the form of higher rates.

For some time now CTA has felt that the first step toward achieving meaningful results in this matter would be to

obtain an independent study as to the effect of these hidden barriers to trade between Canadian provinces. We feel that such a study could best be undertaken by the Research Division of the Canadian Transport Commission within their terms of reference under Section 15 of the National Transportation Act, and would be an important "measure to assist in a sound economic development" of the extra-provincial trucking industry. The results of such a study would be of considerable value in our efforts to try and persuade provincial governments to introduce complete reciprocity on road user taxes. There may be other examples of hidden barriers to interprovincial trade affecting other modes of transport. The Economic Council of Canada might also be interested in doing research in this field.

Just recently, there has been an indication that most of the provinces have agreed to a formula which will substantially reduce duplications in the payment of sales tax on equipment. This initiative, while long overdue, is a step in the right direction. Much remains to be done.

3) Research into Inter-urban Road System to Meet Future Needs of the Economy

The Canadian trucking industry has an obvious interest in the planning for highway construction. It has been suggested, for example, that the completion of the continuous four-lane divided highway from Quebec City to Windsor, Ontario will have a greater economic impact on the communities served than the St. Lawrence Seaway which it parallels. Be this as it may, there is a direct relationship between highway construction and regional economic development. There is also a direct relationship between the construction of divided highways and road safety. The predicted growth rate in automobile registrations, as well as the increasing use of trucks, makes adequate long-range planning mandatory.

The planning and financing of highway systems is clearly a matter of provincial jurisdiction. There are aspects of highway construction, however, with which the trucking industry is definitely concerned. The relationship between highway

construction standards and the sizes and weights of vehicles is of vital concern to the industry.

4) Physical Distribution Problems -- The Problem of Freight Claims and Lack of Uniformity in Packaging Standards

It is generally conceded that the field of physical distribution is wide open for applied research. A particular problem-affecting all modes of transport relates to damage claims to shipments. Such claims represent a significant cost factor for all modes of transport.

In an effort to tackle this problem CTA has, in co-operation with the Railway Association of Canada, set up an inter-industry Committee to study the problem. It is felt that much of the damage to freight which occurs results from the use of faulty materials in packaging or the use of inadequate packaging techniques. It is hoped that the Committee will come up with recommendations for improved and more uniform packaging standards.

In this connection the co-operation of certain federal Government departments might be of use to this Committee at some stage in their deliberations. We note with interest that the Forest Products Laboratory, Forestry Branch, has recently completed studies on the packaging and handling of furniture.

This is an area where co-operation in research projects between governmental agencies and the transportation industry could result in meaningful improvements in freight handling and packaging standards.

5) Acquisitions and Mergers -- Concern Over Foreign Ownership

There is a distinct possibility that control of a major part of the Canadian trucking industry will find its way into the hands of foreign owners within the next few years. Increasing cross-border trade, and the relatively greater size of the average U.S. carrier, will hasten this trend.

Mergers and acquisitions in the Canadian trucking industry will increase significantly in the years ahead. Many of the firms which grew and prospered after the War have been,

or will be sold in the next few years as time takes its toll of the original proprietors. Out of the many thousands of trucking firms in Canada, only a handful of companies are publicly owned. Requirements of liquidity for estate tax planning, among other things, will force many owners to consider selling. The value of a trucking firm to another carrier exceeds the earning capacity of that company as a separate entity. Because 'for-hire' carriers are granted what might be termed "restricted franchises", the opportunity for expanding services to new territory makes such firms attractive to other carriers.

Provincial regulatory boards, generally speaking, have the power to review the authority of a carrier whose operations are being acquired and can, therefore, block a sale. Extra-provincial carriers are also subject to the provisions of Section 20 of the National Transportation Act requiring notice of acquisition to be given in certain cases. It is not clear, however, if the provisions of Section 20 apply to a foreign corporation acquiring a Canadian carrier. In any event, the jurisdiction of the Canadian Transport Commission in reviewing acquisitions is limited to cases where opposition has been filed. The Commission may only disallow an acquisition on the grounds that it will "unduly restrict competition or otherwise be prejudicial to the public interest".

Several of Canada's larger motor carriers are already foreign owned. For the most part, management of these firms has been left in the hands of Canadians and foreign-owned carriers are usually among the most active supporters of industry activities. However, if it is decided as policy that domination of the Canadian trucking industry by foreign interests would be "prejudicial to the public interest", special provision in this regard might be included in the National Transportation Act. Naturally, we would expect the legitimate interests of existing foreign-owned carriers to be respected in any case.

The decision of the Motor Vehicle Transport Committee of the Canadian Transport Commission in a recent case illustrates

the point at issue. The acquirer in this case was a wholly-owned subsidiary of a large American carrier. Objectors raised the question of foreign ownership in argument and suggested that this would be contrary to the "Canadian public interest". In rejecting this argument, the examining Commissioner, whose report was adopted by the Committee, stated in part: "... the proposed acquirer is a Canadian firm incorporated under the laws of Canada and in these circumstances, is entitled, in my view, to the same consideration -- no more, no less -- as would be given to any other undertakings. Nowhere does the National Transportation Act state that foreign ownership is to be a consideration for which the Canadian Transport Commission shall have regard in deciding whether an acquisition under Section 20 should be disallowed". ¹

CTA finds no fault with this reasoning. The decision simply confirms our view that the whole question of foreign ownership in the Canadian trucking industry deserves further study to determine if it is in the Country's long range interest to permit a key segment of the road transport industry to come under foreign control.

The recent task force study on Foreign Ownership and the Structure of Canadian Industry fails to make specific recommendations regarding the transportation industry. Reference is made in the Watkins Report, however, to the fact that most countries treat transportation services as being "key factors" where foreign participation should be limited. We suggest that this matter warrants additional research immediately because of the importance of the trucking industry to the Nation's economy.

¹ Decision of the Motor Vehicle Transport Committee of the Canadian Transport Commission in the Matter of the Proposed Acquisition by Morgan Drive Away Ltd. dated 28 February, 1969 - page 30.

CONCLUSIONS AND RECOMMENDATIONS

In an address to the Canadian Transportation Research Forum in 1965, Dr. John Deutsch, former Chairman of the Economic Council of Canada, stated that transportation accounted for approximately 14% of the GNP. The trucking industry has grown in recent years to the point where it is now of equal importance as a mode of transport as the railways. The predicted growth rate in trucking will only be achieved if the industry is able to retain its inherent advantages relative to other modes of transport. While speed of delivery and flexibility of operation are perhaps the most important advantages of trucking, rising costs must be countered by increased efficiency of operation. In an industry where labour accounts for more than half of the total operating costs, operating efficiency and labour-saving techniques are a prime concern.

Clearly, the trucking industry must substantially increase the amount of applied research being undertaken if it is to achieve reasonable cost stability. While the trucking industry in Canada benefits from much of the research done in other countries, there are some major areas where, because of geography, climate or political considerations, the solution to a problem must have a degree of Canadian content.

Examples can be cited of Canadian motor carriers which have shown great initiative in overcoming adverse operating conditions peculiar to their area of operation. Generally speaking however, few Canadian motor carriers have the financial resources or depth of management available to undertake extensive research on their own.

The situation requires collective action on the part of the industry in setting research priorities and then trying to find the financial means to tackle the problems. Government assistance in key areas of research and development could be of particular value to the trucking industry in the next few years while the industry is in a state of transition and the Associations

Special Committee

are gradually acquiring the financial resources and experienced staff to better serve the needs of the industry. Government assistance might take several forms, and in this connection, we make the following specific recommendations:

- 1) The federal and provincial Governments, in their respective spheres of jurisdiction, should be prepared to work closely with individual companies and associations in a joint sponsorship of research projects. Associations can play a vital role in encouraging and co-ordinating specific research projects to be undertaken by government agencies in conjunction with individual carriers. In this manner, the results of such research will be made available to the widest number of companies, thereby ensuring the maximum advantage from research expenditures.
- 2) The Research and Development Incentives Act specifically excludes research grants to associations and other non-profit organizations. We would recommend that the Act be amended to permit federal Government grants to associations which are in a position to carry out research projects on behalf of the industries they represent.
- 3) Government departments or agencies responsible for conducting transportation research should be encouraged to initiate research projects on their own, which, while of specific interest to a particular mode of transport, nevertheless, are of such general application as to contain an element of "public interest". The problem pertaining to tax barriers to interprovincial trade as they affect interprovincial truck operations, as well as the matter of public policy on mergers and consolidations in the trucking industry, would fall into this category.
- 4) Due to the general scarcity of qualified research personnel in the transportation field in Canada, the federal Government should consider additional means to encourage Canadian universities in assisting industry in carrying out research projects. At the present time,

there are some 375 U.S. colleges and universities offering courses and degrees in fields directly related to transportation. It is felt that one way to encourage Canadian universities to offer a comprehensive range of courses related to transportation is to support transportation research at the university level.

All of which is respectfully submitted,

CANADIAN TRUCKING ASSOCIATIONS INC.

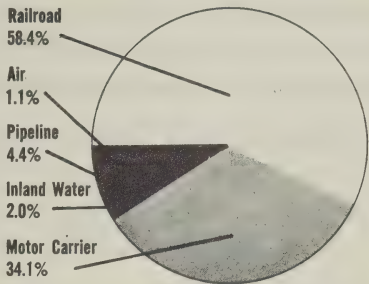
A handwritten signature in dark ink, appearing to read 'A.K. Maclaren', written in a cursive style.

A.K. Maclaren,
Executive Director.

OTTAWA, CANADA

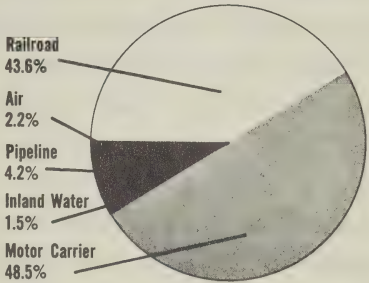
March, 1969.

CHART VII
Revenue Distribution Among Regulated Freight Carriers
ALL MODES
(TOTALS SUMMARIZED IN THOUSANDS OF DOLLARS)



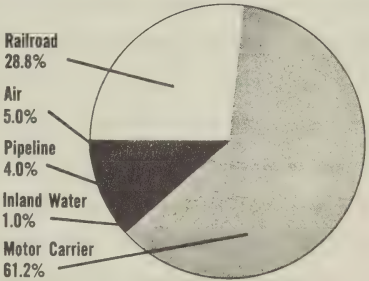
1954

| | |
|---------------|-------------------|
| Railroad | 8,109,577 |
| Motor Carrier | 4,737,120 |
| Inland Water | 282,176 |
| Pipeline | 617,463 |
| Air | 146,579 |
| ALL MODES | <u>13,892,915</u> |



1966

| | |
|---------------|-------------------|
| Railroad | 9,750,959 |
| Motor Carrier | 10,853,300 |
| Inland Water | 328,200 |
| Pipeline | 941,100 |
| Air | 502,616 |
| ALL MODES | <u>22,376,175</u> |



1980

| | |
|---------------|-------------------|
| Railroad | 11,072,328 |
| Motor Carrier | 23,544,727 |
| Inland Water | 384,670 |
| Pipeline | 1,506,468 |
| Air | 1,966,776 |
| ALL MODES | <u>38,476,969</u> |

Extract from 'American Trucking in 1980', Department of Research and Transport Economics, American Trucking Associations Inc.



First Session—Twenty-eighth Parliament

1968-69

THE SENATE OF CANADA

PROCEEDINGS

OF THE

SPECIAL COMMITTEE

ON

SCIENCE POLICY

The Honourable MAURICE LAMONTAGNE, P.C., *Chairman*

The Honourable DONALD CAMERON, *Vice-Chairman*

No. 60

WEDNESDAY, JUNE 11th, 1969

WITNESSES:

Canadian Psychiatric Association: Dr. Robert A. Cleghorn, Chairman of the Research Committee; Canadian Mental Health Association: Dr. John D. Griffin, General Director.

APPENDICES:

- 132—Brief submitted by the Canadian Psychiatric Association
- 133—Brief submitted by the Canadian Mental Health Association

MEMBERS OF THE SPECIAL COMMITTEE
ON
SCIENCE POLICY

The Honourable Maurice Lamontagne, *Chairman*

The Honourable Donald Cameron, *Vice-Chairman*

The Honourable Senators:

| | | |
|--------------|------------|-----------------------------|
| Aird | Grosart | Nichol |
| Bélisle | Haig | O'Leary (<i>Carleton</i>) |
| Blois | Hays | Phillips (<i>Prince</i>) |
| Bourget | Kinnear | Robichaud |
| Cameron | Lamontagne | Sullivan |
| Carter | Lang | Thompson |
| Desruisseaux | Leonard | Yuzyk |
| Giguère | McGrand | |

Patrick J. Savoie,
Clerk of the Committee

ORDERS OF REFERENCE

Extract from the Minutes of the Proceedings of the Senate, Tuesday, September 17th, 1968:

"The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That a Special Committee of the Senate be appointed to consider and report on the science policy of the Federal Government with the object of appraising its priorities, its budget and its efficiency in the light of the experience of other industrialized countries and of the requirements of the new scientific age and, without restricting the generality of the foregoing, to inquire into and report upon the following:

(a) recent trends in research and development expenditures in Canada as compared with those in other industrialized countries;

(b) research and development activities carried out by the Federal Government in the fields of physical, life and human sciences;

(c) federal assistance to research and development activities carried out by individuals, universities, industry and other groups in the three scientific fields mentioned above; and

(d) the broad principles, the long-term financial requirements and the structural organization of a dynamic and efficient science policy for Canada.

That the Committee have power to send for persons, papers and counsel, staff and technical advisers may be necessary for the purpose of the inquiry;

That the Committee have power to send for persons, papers and records, to examine witnesses, to report from time to time, to print such papers and evidence from day to day as may be ordered by the Committee, to sit during sittings and adjournments of the Senate, and to adjourn from place to place;

That the papers and evidence received and taken on the subject in the preceding session be referred to the Committee; and

That the Committee be composed of the Honourable Senators Aird, Argue, Bélisle, Bourget, Cameron, Desruisseaux, Grosart, Hays, Kinnear, Lamontagne, Lang, Leonard, MacKenzie, O'Leary (*Carleton*), Phillips (*Prince*), Sullivan, Thompson and Yuzyk.

After debate, and—

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Thursday, September 19th, 1968:

"With leave of the Senate,
The Honourable Senator Lamontagne, P.C., moved, seconded by the Honourable Senator Benidickson, P.C.:

That the name of the Honourable Senator Robichaud be substituted for that of the Honourable Senator Argue on the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative."

Extract from the Minutes of the Proceedings of the Senate, Wednesday, February 5th, 1969:

With leave of the Senate,

The Honourable Senator McDonald moved, seconded by the Honourable Senator Macdonald (*Cape Breton*):

That the names of the Honourable Senators Blois, Carter, Giguère, Haig, McGrand and Nichol be added to the list of Senators serving on the Special Committee on Science Policy.

The question being put on the motion, it was—
Resolved in the affirmative.

ROBERT FORTIER,
Clerk of the Senate.

MINUTES OF PROCEEDINGS

WEDNESDAY, June 11th, 1969.

Pursuant to adjournment and notice the Special Committee on Science Policy met this day at 8.00 p.m.

Present: The Honourable Senators Lamontagne (*Chairman*), Cameron, Carter, Haig, Robichaud and Yuzyk—6.

Present but not of the Committee: The Honourable Senator Isnor—1.

In attendance: Philip J. Pocock, Director of Research (*Physical Science*).

The following witnesses were heard:

CANADIAN PSYCHIATRIC ASSOCIATION

Dr. Robert A. Cleghorn,
Chairman of the Research Committee.

CANADIAN MENTAL HEALTH ASSOCIATION

Dr. John D. Griffin,
General Director.

(A curriculum vitae of each witness follows these Minutes)

The following are printed as Appendices:

No. 132—Brief submitted by Canadian Psychiatric Association.

No. 133—Brief submitted by Canadian Mental Health Association.

At 10.05 p.m. the Committee adjourned to the call of the Chairman.

ATTEST:

Patrick J. Savoie,
Clerk of the Committee.

CURRICULUM VITAE

Cleghorn, Robert Allen, M.D., D.Sc., F.R.C.P.(C): Born October 6, 1904, in Cambridge, Massachusetts; Canadian nationality; married with three children. Present Positions: Chairman, Department of Psychiatry, McGill University. Psychiatrist-in-Chief, Royal Victoria Hospital, Montreal. Director, Allan Memorial Institute, Montreal. Lecturer in Medicine and Professor of Psychiatry, McGill University. Consultant with respect to seven other hospitals in Montreal. Highlights of Academic Training and Specialization: 1928, M.D., University of Toronto, Ontario. 1932, D.Sc. Physiology, Marischal College, Aberdeen University. 1932-33, Studies at London, England; Pécs, Hungary; Amsterdam. 1943-45, Major, R.C.A.M.C. No. 1 Research Laboratory studying injury in battle casualties, Italy and N.W. Europe. 1945, Certification, Internal Medicine (Canada). 1950, Certification, Psychiatry (Quebec). 1952-54, Psychoanalytic training, Boston Psychoanalytic Institute. 1954-61, Psychoanalytic training, Canadian Psychoanalytic Institute. 1946-64, Director, Laboratory for Experimental Therapeutics, Allan Memorial Institute, Montreal. 1951, Psychiatrist, Royal Victoria Hospital, Montreal. 1960, Professor of Psychiatry, McGill University. Membership in Scientific Societies: Member of 27 scientific and professional societies, including: 1954—Fellow, American Psychiatric Association. 1958—Fellow, American Association for the Advancement of Science, 1962—Associate Member, Canadian Psychoanalytic Society. 1965—Fellow, The Academy of Psychoanalysis. 1965—Fellow, Royal College of Physicians and Surgeons. 1965-66, President, American Psychosomatic Society. 1965-66, President, Quebec Psychiatric Association. 1966—Fellow American College of Psychiatrists. 1966—Member, Board of Directors, World Psychiatric Association. 1967—Chairman, Scientific Committee, C.M.H.A. Other Activities: Member of a number of editorial and advisory boards. Author of 147 published scientific articles.

Griffin, John D. M., M.D.: General Director, Canadian Mental Health Association, Toronto, Canada. Born—June 3, 1906, Hamilton, Ontario. Attended Hamilton Collegiate Institute. Graduated: Arts (Biological & Medical Sciences), University of Toronto, B.A. 1929; Medicine—University of Toronto, M.D., 1932. Postgraduate: Psychology—University of Toronto, M.A., 1933; Diploma of Psychological Medicine (England), 1936. Internships and Residencies: Hospital for Sick Children; Butler Hospital, Providence, R.I., Rockefeller Fellowship, 1934-1936. Appointments: Clinical Assistant, Institute of Child Study, 1933; Psychiatrist, Clinic for Psychological Medicine, Hospital for Sick Children, 1937-1941; Canadian National Committee for Mental Hygiene (now Canadian Mental Health Association), Director of Education, 1936-1939; Medical Director, 1939-1951; General Director, 1952- ; Consultant on Mental Health to C.B.C., 1947-1956; Consultant in Personnel Development, Moore Corporation Ltd., 1946-1952; Member of Committee on Psychiatry, Defence Research Board, 1947-1950. Teaching: Lecturer, School of Social Work, University of Toronto, 1946-1958; Lecturer, Ontario Department of Education, Course on Guidance, 1946-1967. War Service. R.C.A.M.C. as Liaison Officer to Personnel Selection Directorate, 1941-1943; Consultant in Psychiatry to Director General of Medical

Services, Army Headquarters, Ottawa, 1943-1945. Professional Societies: Member of Canadian Medical Association, Ontario Medical Association & Toronto Academy of Medicine, Canadian Psychiatric Association, Ontario Psychiatric Association, American Psychiatric Association (fellow), Canadian Public Health Association, Canadian Education Association. Chairman and member of several committees in CPA and APA. Member of Council APA—1963-1965; President Canadian Psychiatric Association 1967-1968. Publications: Include a book on mental health for teachers and articles in lay and scientific press on mental health, history of psychiatry and organization of psychiatric patterns of care. Married: two sons.

THE SENATE

SPECIAL COMMITTEE ON SCIENCE POLICY

EVIDENCE

Ottawa, Wednesday, June 11, 1969

The Special Senate Committee on Science Policy met this day at 8.00 p.m.

Senator Maurice Lamontagne (Chairman) in the Chair.

The Chairman: Honourable senators, I am told that we have to end this meeting at 10.00 p.m. at the latest because our guests have to take a plane to return to Toronto to attend an annual meeting. We are very happy to have with us tonight Dr. Robert Cleghorn and Dr. John Griffin. I would ask Dr. Cleghorn to make a brief opening statement and then we will have the usual discussion period.

Senator Haig: Mr. Chairman, before Dr. Cleghorn makes his statement would he explain the use of the word "psychiatric"?

The Chairman: This will come out, I hope.

Senator Haig: So that we can understand the discussion, what is the professional society of physicians interested in in the study and practice of psychiatry? What does that mean?

Dr. Robert A. Cleghorn, Chairman of the Research Committee, Canadian Psychiatric Association: Honourable senators, this is a very important and basic question. Psychiatry is the study of the mind with particular reference to those deviations from the normal which may extend up to the point of what we call psychosis or mental illness. It includes the study within psychology not only of normal processes but also of slightly abnormal processes which we see in our friends and relations and which extend to the point of people who have to be cared for in special hospitals.

Senator Haig: Thank you.

The Chairman: So if you could just give us a brief outline.

Dr. Cleghorn: Honourable senators, I will endeavour to summarize, very briefly, the

recommendations which the Canadian Psychiatric Association have submitted in their brief.

Our need, at the present time, is the provision of more adequate financial support in the form of scholarships or bursaries for young psychiatrists who have already qualified in order that they may take research training and undertake the study of many of the vexed problems which still exist in psychiatry. Many of these young people, by the time they have finished their training in psychiatry, are 30 or more and if they go into clinical positions in hospitals or in practice can expect to make a very good living. If they go into research the amounts of money which are available at the present time means that they have to accept something of the order of one-quarter to one-half of what they might expect in practice. Therefore, there are very few who are sufficiently dedicated to devote themselves, to research which is so badly needed. One of the other troubles is that in the study of psychiatry there are so many areas about which little is known and about which there are very few hard facts. If one takes a topic like physics or chemistry, we have hard facts. In the study of human beings we have much fewer hard facts and we need to get more. The areas of study which are needed at the present time are in such things as alcoholism, drug addiction, dissenting youths, forensic psychiatry, in addition to the neurotic and psychotic disorders which are met with in mental hospitals.

University departments are not sufficiently financed at present to permit the appropriate development of psychiatric research although there is a fair amount going on in Canada, but not sufficient.

The relevance of the problems of psychiatry for our social relationships in society are probably of greater importance than are many of the studies in medicine at the present time. Medicine studies such dramatic and well publicized things as heart transplants,

and renal transplants. These are at the forefront of advancing progress in medicine, but they have not the same importance insofar as social issues are concerned, as many of the topics which are studied by psychiatrists. We speak of hard sciences and of soft sciences. The hard sciences, of course, are mathematics, physics, biochemistry and so on and in these areas we have great objectivity and we have established facts which are the same for a person whether he lives in Peru, or India or Canada. In the areas in which we are working, the social sciences, anthropology and the psychologies these issues are much more diffuse and less well defined. We, as psychiatrists, use the studies of anthropologists and of sociologists, as well as those of the biochemist and so on, yet many of our problems deal with soft data which are hard to verify. Our methods for developing objective evidence in many situations are still in the process of development. We need to develop techniques, we need more people to do this and we need the facilities and support for such people.

The Chairman: Thank you very much. I am sure that there will be many questions as we go on and then I would ask Dr. Griffin to make his opening statement and I would like also, while you deal with this, with your opening statement if you could give us the distinction between the two associations.

Dr. John D. Griffin, General Director, Canadian Mental Health Association: Sir, honourable senators, the brief presented tonight from the Canadian Mental Health Association in a very real way is a complementary and supplementary brief to the one presented by the Canadian Psychiatric Association. I will make a distinction between the two associations. The Canadian Psychiatric Association, as Dr. Cleghorn has explained, is an association of professional medical specialists. They are all doctors. They all have special training beyond that of a physician in the specialty of psychiatry. It is therefore a specialists' association.

The Canadian Mental Health Association is a lay organization, a voluntary organization. It is comprised of ordinary citizens, not excluding professionals by any means, and dependent for its leadership on psychiatrists, psychologists and other social scientists from a variety of professions. All of them, however, are interested in the problem of the mental illnesses and more important, I think, in mental health.

So, you see, in a sense the Canadian Mental Health Association is the citizens' back-up group, if I can use that term, to the Canadian Psychiatric Association.

Now, in discussing the brief, Mr. Chairman, I would refer to the summary of our recommendations and call your attention to several facts. Some of these are the same as those that have been dealt with already in the summary by Dr. Cleghorn. But I first would like to underscore the fact that the mental illness problem in Canada is very significant, very serious. It represents a major loss of effective manpower. We have now some evidence—I was going to say "hard" evidence, using Dr. Cleghorn's terms. But I will not do that. It is harder than some of the facts that we have that show us that as much as 25% of the population at one time or another in their lifetime is significantly disabled, at least in part, partially disabled, by a mental or emotional disorder.

Now of this group, a small percentage, perhaps, about 1 to 3 per cent of the total population, might be in the extremely psychotic bracket to the point where they have to be removed to hospital. Perhaps these people are removed against their will, in order to protect themselves and protect society. They have to be removed from their home, from their community and placed in a mental hospital. But this is only a very small group of the total number of people who suffer from a wide range of differing kinds of mental disorders, emotional disorders.

It is hard to believe anyone when he says a quarter of the population is now or will suffer from a disabling disorder,—one that is not really being taken very seriously by scientists or by the researchers. Only recently it is taken seriously by the psychiatrists.

Now, as Dr. Cleghorn has indicated, the concern of psychiatrists in the first instance is in mental illness. Our first concern, as a mental health association is in mental health. We want to do anything that can be done to prevent a breakdown into mental illness. We want to see if we can promote good mental health. These are two areas which are enormously difficult and, in Dr. Cleghorn's terms, very "soft" areas indeed. What do we mean exactly by "mental health"? As Dr. Cleghorn indicated, the mentally healthy person in India may behave in different ways which would not be accepted as mentally healthy in Canada.

Even in one city, in Ottawa, there are certain areas where behaviour of one kind is accepted, regarded as normal, as even healthy. In another part of this same city that same behaviour would be regarded with alarm as being indicative of abnormality. So I point just to that one fact when we start talking about mental health. Nevertheless, we must face up to this. Our association has now started a task-oriented mission in which we have included some of the nation's leading scientists in public health, in sociology, in psychiatry, to look at what can be done now in the way of developing programs which have an impact on the population in terms of prevention and of building good mental health. A kind of mental fitness program. We have heard so much about the physical fitness programs, but no one seems to be paying very much attention to mental fitness programs. We are trying to find out which of these programs could be developed and proven by research to be effective.

Let me just add a word or two to what Dr. Cleghorn said about manpower. In this area we, also, would like to underline the difficulty in procuring, training and maintaining bright young scientists in the field of mental health or mental illness research. The training program takes so long. As Dr. Cleghorn says a man is 30 before he starts even earning his own living as a doctor, and to ask him to take even another 3 or 4 years so he can train himself to be a good research scientist is indeed to ask him to do something rather out of the ordinary and difficult. So we do need support. Of course that means basic salaries must be provided for these men during their research training which will be at least comparable to the salaries and the remuneration that physicians and other scientists are receiving in teaching and administration and private practice.

May I say, just in an aside here, that for 10 years now our association has been sponsoring a research program which we feel was designed to demonstrate the importance of what I have just said. Instead of providing money for a project in this or that problem, we provided for one person each year a sizeable grant, \$20,000.00 to \$25,000.00, in order to let him find himself in a scientific career in research in one of the many professional disciplines related to mental health. For, as you know, it is not only the medically trained scientists who are concerned with scientific problems in the mental health field, so are the psychologists, the sociologists and

anthropologists and from the practical point of view the public health nurses, even school teachers and so on. All have a professional role to play, in our view, with reference to early case finding and preventing more serious problems developing. We also would stress the importance of including in the training of these young professionals, a lively spirit of inquiry. We find that too often when people have established their qualifications as fully trained professionals, they already have lost this inestimably valuable spirit of asking questions and without this eternal curiosity about why things are such and so we cannot have a continuing program of useful research.

I think that we can do something to encourage the development of this inquiring attitude in the people we are training.

We make a point in this brief, sir, that in the last analysis the government must be the source of major funds for ensuring research of this kind.

We would like to suggest that funds be made available that are "secured funds" and by that I mean that they are earmarked for work in the mental health field, that they cannot be slid out from under mental health and put into physical health or into other programs which seem, for the moment, to have a more practical urgency, perhaps a political urgency, which has higher priority than the mental health field. We would like to see funds that are earmarked and thus known to be available so that we have room to grow in this field. We have seen samples of what has happened in other fields. We notice for instance, in the field of agricultural research there is currently something of the order of \$30 million or \$40 million set aside and this seems to be arranged each year regardless of what has happened, perhaps increasing gradually over the years.

The Chairman: You can double that amount.

Dr. Griffin: All right. Let us look at the urban situation and ask how much has been spent on urban housing research that affects people rather than animals. You know we find that the amount spent is very much less. Why has this been allowed to develop? Simply because it always has been that way and no one has asked questions. We are now asking questions. Certainly when you come to human ecology, human mental well being, human housing, human poverty, then these are certainly soft areas in Dr. Cleghorn's ter-

minology but these are ones that require a little bit of evening up of the money available for research. Not that it should be taken away from agriculture. Agriculture is important. So are pigs. I would only say surely humans are equally important.

So I have made the point about careers in research, getting people to devote their time for research so that they can have a career, a rewarding career in research and not just a sparetime activity.

I would suggest then, as a science policy and I keep remembering that you are concerned not so much with details but with basic policy, that there are two kinds of research that affect human mental health; One of these we would call "basic research", this has to do chiefly with a delving in to the basic biochemistry, basic pharmacology, the basic sciences that relate to human behaviour. There is another kind, which you might call "applied research", that relates to these vast "soft" areas that I have just mentioned. I would include poverty, housing, prevention and mental health and a number of others in this. These are applied areas, they are social issues and they are heavily overlaid with social policy and political policy. But very little research has been done in any of them because they are difficult areas. But the impact of them on the mental health of the people is of undoubted importance. In the view of our association, these require task-oriented missions which can only be undertaken by governments perhaps in cooperation with professional and voluntary associations. Whereas the basic research, the project research, is best placed in universities where these people have a laboratory and perhaps a community that is under constant study that they can utilize as their laboratory. We have to think in national terms, not in parochial terms and not in terms of the individual, but with large clusters of people, whole communities. As I say, it is a national problem and studies like this I would suggest, have a more appropriate base in government directed task-oriented research missions utilizing the strength that they find in universities and, if I may say so, in places other than universities such as our associations.

By no means are all of the people presently engaged in preventive mental health programs, in the universities. For instance there are some very outstanding public health doctors who are developing excellent mental health programs who have nothing more than a peripheral contact with the local university.

I would also make the point that in a kind of research program that we are interested in, (large task-oriented missions) many scientists with different types of professional backgrounds are required. They must be involved so that they will work together as a sociologist, anthropologist, a psychiatrist, a psychologist, perhaps an educator. They have to be brought together as a team. We are beginning to develop experience, successfully in this task. We are just completing, for example, a very intensive study on the problem of emotional and learning disorders of small children. Here again there is a problem that affects up to 10 per cent of all children, something that the public just cannot really grasp in terms of its extent.

Senator Yuzyk: How would you describe the "small child"?

Dr. Griffin: Elementary school age and prior to that, preschool and elementary school age.

We have our task force working on this and the report will be out this summer; educationists, psychiatrists, child psychologists, social workers, sociologists, a group of 12 such people, and they have gone throughout the country and examined projects, "on-site visits", they call them, looked in depth at certain things that certain schools are doing, that other clinics are doing and brought all this material together. They are writing up their report now to be a guideline for the nation. This is the sort of thing that I have in mind that needs help. We had a rather difficult time getting financial support for this. We got it from the federal Government, the Department of National Health and Welfare, gave us a grant, but by no means a generous grant. Every province...

The Chairman: What was the amount?

Dr. Griffin: They had two actually, one was \$17,000 and I think another one was of the order of \$20,000.

The Province of Ontario gave us about \$70,000. The Province of Quebec a substantial amount, about the same, \$60,000, every other province, save two, and I will not name the two that did not. But it came, in every case, from the Departments of Education, not from the health or welfare side. In addition, sir, we had support from foundations, private foundations. This is the value of the flexibility provided by an outside organization doing work supported by government. For the cost of, let us say \$30,000 of federal Government

money, you are getting a \$250,000 project carried out with great dedication and zeal. So you see how this can work.

Finally, our closing recommendation has to do with the plea that thoughtful consideration should be given to something like a national mental health research institute. We are very proud in Canada of the Medical Research Council and we recognize that the Medical Research Council now has more funds at its disposal than it ever had before. This is good. We recognize that the Medical Research Council is supporting basic research in the social science field, in the psychological field. But it is not yet sufficient in my opinion. There is not yet much in the psychiatric field because, as Dr. Cleghorn has said, there is so much in this field that must seem to the hard-nosed scientists to be fuzzy and unclear. But until we start to look at it in a scientific way, we will never get clarity. So the Medical Research Council, I feel, needs to be encouraged and supported in developing a special interest in this field. I look, with a great deal of longing, at the United States' pattern where they have a national institute for research which has over the years accomplished a great deal. They even have supported some projects in Canada, as you all know, of course.

Now, they are withdrawing the support from other countries including Canada and we are being left a little embarrassed, because of lack of funds from the United States which we formerly had.

I would say that the field of mental retardation, through the work of our sister organization the Canadian Association for Retarded Children, has already, on its own, established a national institute for mental retardation. I think this is a little sad. I must say that because I would much rather have seen a government institute for the total field of mental health and mental health research, but nevertheless, this may be a spur to something else.

Sir, I have spoken too long, but ours is a difficult field to summarize.

The Chairman: Thank you, very much, Dr. Griffin. It was a very good presentation. We are dealing tonight with a very important problem in the sense that we have been told that perhaps 20 per cent of our population is affected by some kind of mental dis-equilibrium. I think, as we become more affluent in this country, the percentage will increase. This is a very important problem.

Before I ask Senator Carter to begin the discussion, I would like to ask Dr. Cleghorn why is it that the Medical Research Council does not have, at this moment at least, a special committee? They have a whole series of special committees dealing with all kinds of diseases but I understand that there is no special committee dealing with research in psychiatry.

Dr. Cleghorn: Sir, that would be a little hard to answer. I have sat upon the Medical Research Council committees for clinical investigation and I know that it was the late Dr. Farquarson's intention to form a section as far as psychiatry is concerned. Dr. Malcolm Brown, the chairman, has brought in other psychiatrists, Dr. Epstein of Hamilton and Dr. MacLeod of Montreal, so that they sit on the clinical investigation committee. But I really don't know why there is not a special one, unless it is this, that there are simply not enough applications to the Medical Research Council from psychiatrists to call for a special committee. I find that a little hard to believe. The other aspect of the thing is that I think that Dr. Brown and many other people feel that they should keep psychiatry more closely in touch with medicine so that the medical people can apply their rather more severe forms of objective criticism to psychiatric projects than perhaps the psychiatrists would do themselves. Further than that, I cannot say, but the situation, of course, is much better now. The appropriation for psychiatry has gone up this year to a figure in the order of \$600,000.00, but that is for Canada and it still is not on a par with anything like the United States.

A few years ago some of my colleagues, and I did a survey for the psychiatric association, we compared the amount of money spent in New York State, which has a comparable population to Canada, and they were spending, I believe, \$14.5 million on psychiatric research at that time when we were spending \$1.3 million, from all sources. I do not think that the situation has been thoroughly rectified since.

Senator Yuzyk: Just a follow-up question. Has the Canadian Psychiatric Association made representations to the Medical Research Council regarding this special committee on psychiatry.

Dr. Cleghorn: I would say they have not. Both Dr. Epstein and Dr. MacLeod, who are on the clinical investigation committee of the research council are members of the Canadian Psychiatric Association.

The Chairman: But you have not make representations to have a special committee?

Dr. Cleghorn: No, we have not.

The Chairman: Senator Carter?

Senator Carter: Mr. Chairman, if we have only got until 10.00 o'clock we are not going to have much time to get answers. We will have to have short questions and short answers.

The Chairman: You have an hour and a quarter.

Senator Carter: Dr. Cleghorn, I take it, is a medical doctor and a professional psychiatrist. Is Dr. Griffin a medical man too?

Dr. Griffin: Yes, sir.

The Chairman: And a psychiatrist?

Dr. Griffin: Yes.

The Chairman: And a layman too.

Senator Carter: Yes, and a layman too. I think we should follow the example set by Senator Haig and perhaps get our terms on the record, just what we are talking about, for the sake of lay people.

In both your briefs you say how difficult it is to define mental health or mental illness in terms, and yet in your briefs you say that the cost of mental illness in Canada is around \$700 million a year. Now, that figure must be based on some sort of a definition. We should have that on the record so that we know just what our terms are. Can you give us, either one way or the other, the terms?

Dr. Cleghorn: I would say two or three words and then toss it to Dr. Griffin. For the upkeep and maintenance in mental hospitals across the country and in the psychiatric divisions of general hospitals throughout the country and in other affiliated clinics dealing with mentally and emotionally disturbed people we have the basis for that expenditure.

Dr. Griffin: And mental illness, sir, is a recognizable disorder of thinking, feeling or acting as compared to physical illness which is a disorder of an organ.

Senator Carter: Is there a world health definition that is generally accepted, because you could hardly come to a finite figure of \$700 million on that type of definition that you have just given. There is something wrong with your thinking, feeling or perception, everybody would be in.

The Chairman: It would imply senators too.

Senator Carter: Yes, even senators.

Dr. Cleghorn: I will not deny the fact that everybody is subject to disorders in these fields, in various degrees of severity, but the degree of severity that indicates a disorder, I would prefer the term "disorder" than illness, the degree of derangement classed as a disorder is something that handicaps a person, that makes him unable to work or to fulfil his role as a parent or her role or to be in fact an independent citizen. Now, if he is incapacitated that way, other than just a refusal to work through laziness or that sort of thing, that may be a kind of emotional illness too. But these are recognizable.

The Chairman: I don't think he would be the perfect type to be adjusted to the new efforts.

Dr. Cleghorn: Perhaps.

Senator Yuzyk: These are really misfits in our society, would you say that, in general?

Dr. Cleghorn: The establishment regards them as misfits, in fact there is some danger here in confusing what are misfits in that sense, and what is mental illness or mental disorder. We get confused all the time between what is being mad and what is being bad, what is being sick and what is being sinful, you see, and we have got this division between those two things and it is very, very difficult. Sometimes the psychiatrist finds himself in a bad spot when he is asked to come to court and testify that this man is not bad even though he has murdered somebody. He is just sick. Everybody, of course, accuses the psychiatrist of being soft-headed and not knowing what he is talking about because the person actually killed somebody.

Senator Carter: I must say the doctors who analysed this fellow that shot Robert Kennedy...

Senator Yuzyk: Sirhan Sirhan.

Senator Carter: ...came up with some very funny diagnoses.

Dr. Cleghorn: They certainly did.

Senator Carter: When I read it I wondered if they themselves understood what they were talking about.

Dr. Griffin: A shameful exhibition, sir.

Dr. Cleghorn: May I add that I have been asked to take part in a panel, sometime in the future, on the abuses and uses of psychiatry, and this is one of the abuses of psychiatry.

Senator Carter: I am glad to know that.

Now, I would like to follow on Senator Lamontagne's question. You make a big point, in your brief, that this is an area of medicine that has been badly neglected. You say that to correct the thing you really need a crash program almost starting from scratch and building up a body of scientists to carry on this work. You say that they have to be given some sort of permanent security, security of tenure, to stay on the job for a sufficiently long period of time to produce some results. Coming back to the neglect, has the MRC neglected it, have they been just one-sided on this?

Dr. Cleghorn: It is rather like criticizing myself since I had sat on the MRC. I think that they have been perhaps a little tough minded because they are scientists and they are supporting scientific endeavour and they are doing this in a variety of fields where there are hard facts but in the field of psychiatry it is much more difficult. They have supported, to their credit, some young men who are working on what we call soft areas. For example one program they have supported, of which I have some knowledge, is a study of adolescents, some of whom are crazy, schizophrenics, and some of whom are just maladjusted, bad boys. They have supported this and it is very difficult for us to apply strict criteria to differentiate these two groups of people because it is very important to know whether a 16 year old, who has played hooky and stolen some things, is really going to end up as a chronic mental case or whether it is going to be possible to straighten him out and make him a good citizen.

Senator Carter: The point I am trying to get at is that you have medical doctors on the MRC, and you may have a psychiatrist or two with them, but have they down-graded this in their priorities. Is this something they don't think is as important as other areas of medicine?

Dr. Cleghorn: Correct.

Dr. Griffin: Correct.

The Chairman: Is it because of the criterion that they are trying to apply of excellence so that we would not, in psychiatry, achieve the degree of excellence achieved in other fields

of medical research, or is it because this field has been objectively neglected?

Dr. Cleghorn: It is not objectively neglected. It is not a matter of ill will, but it is a matter of the more recent growth of this discipline or psychiatry because the development of physics, mathematics came first, then physics, then chemistry, then biology.

The Chairman: We are speaking now about the Medical Research Council?

Senator Carter: Yes.

Dr. Cleghorn: Well, the development in interest in psychiatric problems came late because the establishment of psychiatry in Canada as a modern discipline only dates from about 1945. It just is the historical development of the thing that it did come late and so it has not had the opportunity to develop as well. Furthermore, there is another aspect of it and that is that people are almost universally a little afraid of psychiatrists. We are called "head shrinkers"! There are the greatest number of jokes, all the way from the New Yorker up about psychiatrists and they are all degrading or laughing at psychiatrists. Now, I think we have done some things which are laughable, but on the whole our hearts have been in the right place if even sometimes our manners have not been. So that there is also this attitude of slight suspicion that we are not quite kosher, we are not just as reputable as the hard scientists and we are dealing with something perhaps a little close to magic. We are the modern witch doctors, if you like, we don't like to think it that but there is all this aura about it.

Senator Carter: What is your solution to that? If you talk about earmarking money, if the Government gives grants, makes money available to the Medical Research Council, it leaves it to MRC to allocate it. The Government does not earmark it. How do you overcome that difficulty or are you asking for another council to look after mental health—a mental health council to handle earmarked funds? You would have a separate council with funds earmarked for it. Is that what you are asking in addition to MRC or do you still want it handled by MRC?

Dr. Cleghorn: My thinking has not gone that far.

Dr. Griffin: Well, I have, perhaps foolishly, in my anxiety. I am a lot less scientific than Dr. Cleghorn and I want results while I am

still here to enjoy them. I would like to see earmarked funds and I would like to see either the Medical Research Council constitute a special committee on mental health research or psychiatric research, if they want to call it that, with a definite proportion of their budget earmarked. If, in fact, what we say about the number of patients, disturbed by mental disorders is as I have indicated, then these people number about half of all the people who are disabled at any one time. They are disabled because of disorders in our field, not another field of medicine.

Senator Carier: But you have not been able to sell it to MRC; how are you going to sell it to them

Dr. Griffin: They will learn soon enough if they would get started in the thing.

The Chairman: Before we reach MRC, we should go back to university teaching.

Dr. Griffin: I have suggested that this committee on science policy think of other ways in which this can be secured.

Senator Carier: You are not asking for a separate council, I take it?

Dr. Griffin: Well, I say this is one model and the reason I have pointed to that, sir, is that there is already a national institute on mental retardation, this bothers me because there is not yet, in Canada, a national institute on mental health.

Senator Carier: We have not heard from them yet. Are they coming?

The Chairman: I do not know.

Dr. Griffin: At York University.

Senator Cameron: Mr. Chairman, on this very point, it strikes me as strange that we spend "X" millions of dollars on a national physical fitness program, one in which we are trying to build up a national hockey team, and we are spending nothing on this.

The Chairman: Do not start trouble.

Senator Cameron: I know but I am just asking has any money been provided in this area from the Department of National Health and Welfare?

Senator Carier: Oh yes.

Senator Cameron: Just a very little.

Senator Yuzyk: A bit.

Dr. Griffin: I don't know whether I am letting any cats out of the bag. We are approaching this department very shortly for some help for this new mission which I have just described, chaired by Dr. John B. MacDonald, who I think you already know, and he is interested in this problem and we hope to have some help to do some studies in prevention and in building good mental fitness. Now, this is the first of its kind in Canada. The very first time.

Senator Carier: Supposing you had the money, it doesn't matter how it comes, say \$2 million, the first thing you are going to do is collect a group of scientists. Where are you going to get them? Are they available here in Canada now?

Dr. Cleghorn: No, they are not, we would have to take young men who showed an interest in these areas and give them (a) a problem to work on; (b) supervision; and (c) the place and the opportunity?

Senator Robichaud: How many psychiatrists are there in Canada today?

Dr. Griffin: There are 1,500 members in the Canadian Psychiatric Association. Of these over 1,000, about 1,200, are fully qualified psychiatrists. The others are learning.

Senator Robichaud: What percentage of those are employed by provincial governments or in government institutions?

Dr. Griffin: About one-third, I believe.

Senator Carier: Would it not be better to send them away? You spoke about the National Mental Health Foundation of the United States, and the European institutions which are very progressive in this. Some people think they have a creative attitude, programs even better than the United States. Would it not be better to get these people trained in the best institutions so that they could come back and work?

Dr. Cleghorn: In the first place we think we could train some ourselves but we certainly...

The Chairman: Because, as you say in one or the other brief, very often the origin and the source of these diseases are very local and regional.

Dr. Cleghorn: We could train let us say half and I would like very much to send others away. One of the difficulties about sending

them to the United States is that if they happen to be bright they stay.

Senator Carter: Not if you had them under contract.

Dr. Griffin: Not if they are of draft age.

Senator Yuzyk: Are there departments of psychiatry at our universities in Canada?

Dr. Cleghorn: Yes, there are.

Senator Yuzyk: How many?

Dr. Cleghorn: I would think about 12.

Senator Carter: Supposingly you have the scientists now and they are sufficiently trained to initiate their work, what areas would you start them out in? What is your number one problem?

Dr. Cleghorn: Well, in the first place there is a peculiarity here in that they have to be allowed to work in the area in which they find an interest. They can be exposed say to alcoholism or addiction but not all of them will want to work on that. Some of them will want to work on sick families, some of them will want to work on adolescents, some of them may want to work on geriatrics, old people, and a research worker has to have the driving force of his own interest in the problem in order to work successfully, so you cannot just regiment them and apply them.

Senator Carter: That cuts out the argument Senator Lamontagne made a few minutes ago that different types of illnesses are indigenous to certain localities.

The Chairman: Well, there is that kind of significance too, I think.

Dr. Cleghorn: Yes.

Dr. Griffin: May I just give an example of this? In Montreal, there is an area that has been given very close study by McGill University, an area of slums and of low income families and they have found that the psychiatric problems emerging from that area are many indeed, in fact proportionately greater than in any other part of the city. They require a very special kind of psychiatric help. They will not come to a clinic, for instance, the psychiatrist, very often, has to go to where they live, to their own homes. So there are a lot of characteristic disorders that are only applicable to one area. And there are psychiatrists now, such as Raymond Prince,

who are beginning to be very interested in this as their problem.

Senator Cameron: Did he not do a study on a slum area in Montreal which was reported in the housing projects?

Senator Carter: I had a case of a veteran who came back from the Second World War. He had been a fisherman before he enlisted and he went back to his occupation after discharge. He carried on for several months and then one day he pulled up his boat and went ashore and would not go out of doors. They could not get him to. He refused absolutely to go outside. He just sat there, sitting around and eating and getting fat. Obviously there was something wrong with him, but he would not go to see a doctor nor would he allow a doctor to go and see him. It took about five years to convince the authorities that this fellow was mentally ill. Eventually he qualified for a War Veterans' Allowance. That is the sort of strange thing that happens.

Dr. Cleghorn: May I mention another strange thing which was reported in the newspapers, and that was when the goalie for the Montreal Canadiens hockey team refused to fly back from Chicago.

The Chairman: I thought you were going to mention Tom Katz from Toronto.

Senator Cameron: High rise!

The Chairman: A new phenomenon in the national news last night.

Senator Haig: I ask this question of either one of the witnesses; is mental illness increasing or are we finding more abnormal persons?

Dr. Cleghorn: The answer to that, Senator Haig, is that I will say we don't know.

Senator Haig: Your mental hospitals are increasing?

Dr. Cleghorn: Decreasing.

Senator Haig: In other words the patients in the mental hospitals are decreasing?

Dr. Cleghorn: Exactly.

Dr. Griffin: May I explain why, sir? The mental patients in mental hospitals are decreasing because of a new policy that has now been introduced throughout this country, namely, patients will no longer be kept in residential, custodial care in our mental hospitals as they have been for 100 years. When there is nothing more to be done for them,

except to look after them and keep them behind locked doors, the policy now is to get them out into the community, to find nursing homes, foster homes, boarding homes. The result is that communities throughout the country are beginning to absorb these ineffective, non-integrating people in the thousands all over the country.

Senator Cameron: My second question is: does mental illness affect certain age groups?

Senator Carter: Only senators.

The Chairman: We have our special sickness here.

Dr. Cleghorn: It affects all age groups. Certain types of illnesses affect certain age groups. For example, the illness of schizophrenia is apt to affect a younger age group than the changes which are appropriate to great age which may lead to senile changes with mental aberrations and so on.

Senator Haig: May I suggest that psychiatry is not an exact science?

Dr. Cleghorn: It is not.

Senator Haig: Thank you. Where is the research needed that you request, in the area of prevention or of cure?

Dr. Cleghorn: Both.

Senator Haig: In other words, the Mental Health Association recommended a co-ordinated research program and multi-disciplinary research, is that right?

Dr. Griffin: Yes.

The Chairman: I did not make a speech when I asked my questions, I just asked the question.

Senator Carter: Very much to the point too.

Senator Cameron: A model question too. The two witnesses tonight have emphasized something that many previous witnesses have emphasized, and that is the need for a multi-disciplinary approach. How many and where are the institutions in Canada, as of now, where this multi-disciplinarian approach is available?

Dr. Cleghorn: I would say, senator, there are about 4 or 5; at McGill, Dalhousie, to a lesser extent, Toronto, Vancouver. Now, there is some good work done by individuals, let's say at Saskatchewan and Manitoba but the

larger programs are at the places I have mentioned.

The Chairman: Are there any in French?

Dr. Griffin: Any French universities?

Dr. Cleghorn: Yes, some very good work going on in Montreal particularly the starting program at Laval.

Senator Cameron: So that is at the most six centres.

The Chairman: I know a friend of mine, Dr. Voyer, who has been starting a kind of completely new experience in Hawkesbury for retarded children. Apparently it is a wonderful experience. I do not know if it is unique.

Dr. Cleghorn: Victor Voyer.

Dr. Griffin: He was with me in the army.

Dr. Cleghorn: He was with me in the army.

Dr. Griffin: Both of us.

The Chairman: I am going to speak there in about ten days. Apparently it is a unique experience.

Senator Cameron: You have indicated, both of you, that there is a need for a minimum annual salary to attract and retain people in the field of mental health research. I gathered from what you have said that under the present circumstances for the person to go into research in this field it is equivalent to starving in the garrets in the art fields. But what do you think would be a reasonable minimum annual stipend for a researcher and how many of them could be put to work in Canada? Have you any idea what a reasonable total budget might be on an annual basis?

Dr. Cleghorn: I would have to do some paper and pencil work on that. I would think that a basic minimum salary for a young man who has finished his psychiatric training and wants to train in psychiatric research would be of the order of \$16,000.00 which he could earn from, let's say, the Quebec Psychiatric Service.

The Chairman: Do I understand, Senator Cameron, I was led to understand there was a great gap between those who devoted their life to research in your field and those who were practicing.

Dr. Cleghorn: Exactly.

Senator Cameron: Yes.

Senator Haig: Excuse me, does a psychiatrist have to be a medical doctor?

Dr. Cleghorn: Yes.

Senator Cameron: \$16,000.00 would be a minimum?

Senator Yuzyk: Is that not very low?

Dr. Cleghorn: It is low.

Senator Carter: That is low even with general practitioners.

Dr. Cleghorn: You asked for a minimum.

Senator Carter: You would not get anybody for that, anybody worthwhile.

Dr. Cleghorn: I have several worthwhile people working for less than that. It makes me somewhat embarrassed.

Senator Cameron: How many do you think would represent a reasonable program for Canada?

Dr. Cleghorn: It would have to be in stages.

Senator Cameron: Five year programs?

Dr. Cleghorn: In the first five-year program I would think one would need something between 30 and 40.

Senator Carter: You really want \$1 million. You need facilities too.

Dr. Cleghorn: Oh, yes. There are facilities at many places, and a lot of psychiatric research, of course, can be done with interviewing by the use of data compiled and then analysed on computers, and so on. The facilities for biochemical research done in the psychiatric field are reasonably good and there is quite a lot of excellent biochemical research going on already.

The Chairman: You have to deal not only with disease when it develops, but you have also to try to prevent disease or disorders. Do you think this is enough? Prevention, it seems to me, especially because you are dealing with soft knowledge, is perhaps more important than the cure after the disease has developed.

Dr. Griffin: May I try my hand at this one? We think the research and study into preventive programs, sir, would develop largely in communities rather than in laboratories.

The Chairman: A completely different approach.

Dr. Cleghorn: Yes, and we really wouldn't require so much laboratory facilities as perhaps conveniences for interviewing in groups, for working with groups of people in two's and three's and larger groups. We would work in schools, in institutions, but go in where the people are to do our work.

Senator Carter: You would need computer facilities. Dr. Griffin, in your opening statement you drew attention to Ottawa, to different types of behavior by people in one part of Ottawa and people in another part, and the fact they are both apparently normal or accepted as normal for those areas. Now these different types of behaviour must be due to different causes. Therefore, if you were going to do any research you would have to go to the causes, to the background. So you would really need to use a computer, wouldn't you, to gather this information, not only in Ottawa but different parts of Canada?

The Chairman: You are asking for this too?

Dr. Griffin: I am sure we would have to use that kind of equipment including also use of varieties of sampling devices, questionnaires, that kind of thing. However, don't hold me to this model which I presented which was really a sociological model. I was talking about the difficulty in defining mental health and what is good for eastern Ottawa as mental health would not be quite the same as in Rockcliffe, let us say. That is all I have said.

Senator Carter: My friend Senator Haig asked for average and normal, who is abnormal, the fellow in Rockcliffe or the fellow in east Ottawa?

The Chairman: No, but for the same individual there might be a different behaviour pattern during the day.

Senator Haig: My question was written down and it was: is mental illness increasing or are we finding more abnormal persons? I did not mention anything about Rockcliffe or the Ottawa area.

Senator Carter: But you just spoke about abnormal people. Who is abnormal?

Senator Haig: Don't ask that question of us because we have got a certain opinion.

Senator Robichaud: I would like to come back to one of the first questions that was

asked regarding the statement made by Dr. Cleghorn and Dr. Griffin to the effect that there seemed to have been a lack of interest on the part of MRC in assisting research in psychiatry or mental health. Now, is it not a fact that there seems to have been, all along, a lack of a clear definition between the responsibilities of the federal Government and the provinces? As a matter of fact, the federal level of Government has been assisting, for example, in the construction of hospitals, assisting the provinces financially. It has refused to participate in the construction or maintenance of mental institutions, so is this not a factor that could affect the policy of MRC? Maybe there needs to be a clearer definition in this field.

Dr. Griffin: I would agree. You know the origin of this because the mental institutions and sanatoria were provincial institutions as opposed to other ordinary hospitals and I am sure that Senator Robichaud knows that. He is right just the same. Many of the general hospitals are provincial institutions too and it has been a long standing worry to the Canadian Mental Health Association that the federal Government in producing this excellent plan for hospital insurance carefully ruled out mental hospitals. I think this has resulted in a discrimination, if I may say so, against the mental hospitals. They were not really good enough institutions to be included in what was allright for general hospitals.

The Chairman: Which was not the explanation in the beginning.

Senator Carter: But they also ruled out tuberculosis hospitals.

Dr. Griffin: Yes, they did.

The Chairman: For the same reasons, they were provincial institutions.

Senator Carter: Not because of the standards in the hospitals but because they were provincial institutions.

Dr. Cleghorn: May I take up this point a bit? Provincial mental hospitals, until the past 25 years, were neglected institutions. Now only have they began to assume a scientific attitude and to attract more able people in greater numbers. Under the circumstances, in the 1920s and 1930s, when medicine was going ahead well in general hospitals the mental hospitals did not have the personnel or the equipment to make advances nor did they have the stimulus because the stimulus for advances in psychiatry only came in the

thirties with the introduction of shock therapy and insulin, and so on. So it was only at that time that research got going in the mental hospitals and it was only in the forties that the general hospitals opened up psychiatric wings and it has been demonstrated, and quite clearly, that the support and stimulation of the universities in promoting research has been of cardinal importance. It is only in the last few years that the universities throughout the country have become co-ordinated in their efforts to support mental health research.

Senator Carter: Is not the modern trend now towards psychiatric wings rather than to separate institutions?

Dr. Cleghorn: Correct.

The Chairman: Can we go back to university teaching and ask the following question: are the future doctors in faculties of medicine obliged to take courses in psychiatry?

Dr. Cleghorn: They are. I had two hours, an undergraduate student now has 300 hours.

Senator Robichaud: As a follow-up of this question, is it not a fact that the introduction of Medicare, particularly when it will apply on a medical basis, will have some influence in changing this current policy of MRC?

Dr. Cleghorn: I would hope so. I would like to defend MRC a little because since 1960 I think they gave \$40,000 for psychiatric research, and this year \$640,000. That is a big increase. We do not, at the receiving end, feel that this is yet enough. It means changing the attitude of doctors who are on the panels of MRC as well as getting more psychiatrists interested, and the number of psychiatrists in the country who are qualified as research workers is very small.

The Chairman: You do not have a special problem as opposed to the medical doctor, the ordinary medical doctor, in the sense that your approach, if it is to be successful, has to be multi-disciplinary at the stage of prevention.

Dr. Cleghorn: It has to be multi-disciplinary.

The Chairman: So the sociologists or anthropologists would not be eligible for grants in your field of research from the Medical Research Council.

Dr. Cleghorn: Probably not.

Dr. Griffin: I would say that the experience of those physicians in general practice or, shall I say, family practice who are not psychiatrists now is almost universally producing evidence that a very large part of their practice is made up of people who are psychiatrically ill, primarily. Now, two things have happened, or are happening. One is that the general practitioner is getting more training in psychiatry in his medical school than he did before, but he is also getting much more demand for this from the public. So it is feeding back that way. The second thing is that this undoubtedly will have an impact on Medicare because he has got to be paid for the time he spends with these people who need his care. A third thing is that unless the family doctor is able and willing to handle these cases we are really in a very bad position because there are not now, nor will there ever be, enough psychiatrists to handle all of these.

The Chairman: But at least they will have to know something about this science. I had a lot of friends who were doctors—and I am not speaking of any recent years—who despised psychiatry. They didn't know anything about it. I am glad to know that this is changing. They now have to be exposed to the teaching of this new science which is supposed to be curing the sickness of civilization.

Dr. Griffin: It has a long way to go.

Senator Cameron: A very useful approach would be to start even beyond the medical practitioner, further down in the schools. The thing that has bothered me as an educator,—and this came up in our Royal Commission on Education in Alberta, is that we did not have enough guidance counselors, and very few school divisions, even the big ones like Calgary or Edmonton, had psychiatrists on their staffs. This seems a logical place to discover incipient deviates at an early age, so that the need of trained personnel goes away down the line right to the school system.

Dr. Cleghorn: Exactly.

Dr. Griffin: I have devoted 20 years of my summers to teaching guidance teachers to do a better job in this kind of preventive work in the Toronto area.

Senator Carter: I have a few more questions, Mr. Chairman.

As I understand it, there are two broad categories of mental disorders, one is what you call neurosis and the other is psy-

chosis. Are there other categories? As a layman I am not very clear as to what the distinction is between them.

Senator Robichaud: You are not talking like a layman now.

Senator Carter: I would like you to enlighten us on that as they merge into one another. Is there a clear-cut line?

Dr. Cleghorn: There is no clear-cut line. A person with neurosis may develop a psychosis and floats in and out of psychosis, in and out again, and when they are treated they get better and then they lose their hallucinations, their delusions, which are manifestations of psychosis and they slip back to their ordinary neurotic state where they are all right. They still may not be able to fly in airplanes, or whatever their problem might be. Does that answer your question?

Senator Carter: Well partly yes. Where does anxiety come in?

Dr. Cleghorn: Apparently anxiety begins at birth but when anxiety becomes disrupting then you can call it neurotic anxiety, if it is so disrupting if the hockey player cannot play hockey and becomes so disorganized or that the business man cannot carry on his business, then one can call it neurotic.

Senator Carter: What do you call it when the person's inter-reaction to his environment is such that he just gives up—he gets this feeling of helplessness, gives up and possibly commits suicide eventually? What do you call that?

Dr. Cleghorn: Presumably one would call that depression.

Senator Carter: Is that neurosis or psychosis? Where does it fit in?

Dr. Cleghorn: It is a neurosis until such time as you can say it is unreasonable. If a person loses somebody close to him, he will become sad and if he remains sad for let's say six months and unable to work, then one says that that sadness has moved over into depression and that is a neurotic depression.

Senator Carter: There is another category, I gather, which is called catatonic, whatever that means.

Dr. Cleghorn: Yes.

Senator Carter: Whatever that is, it is disappearing in the United States and Russia.

Dr. Griffin: And in Canada.

The Chairman: I was going to ask what is happening in Canada. Depression is increasing in the U.S.A. and Russia, and in Canada too.

Dr. Cleghorn: We have begun to recognize it more in many situations where we previously did not recognize it. Whether it is increasing or we are just recognizing it more is impossible to say.

Dr. Griffin: May I add a bit to that? Many of the basic symptoms of depression are now recognized to be physical; loss of appetite, loss of sleep, stomach complaints, and all the rest, may be the first signs of depression that bring the person to a doctor. These were not recognized as the symptoms of depression before.

Senator Carter: Well, in your prevention, these symptoms, the case of the chicken or the egg, which came first, you are saying the depression comes first and the other comes second, the ulcer comes second. Some people say these things lead to ulcers and cancer and all that. If you are going to research into prevention where do you start on that, have you got any clear-cut evidence as to which is which on that?

Dr. Cleghorn: Well, we think we have and this is the soft area of research because we believe that certain people respond poorly to adversity and we think that we can say, in certain instances, why these people respond poorly. Whereas, other people seem to have greater bounce and recover from adversity and the physical symptoms, I think one can say definitely, probably come secondary to the emotional disturbance rather than first. Now, if one develops, shall we say, a severe disease such as paralysis of muscles which may occur in some physical diseases then one can justifiably be unhappy and depressed about it or if one has an incurable disease, so that then the depression or the emotional disturbance is secondary to the physical one which may be a very grave disorder.

Senator Yuzyk: Dr. Griffin, who comprises the Canadian Mental Health Association? In Appendix 2, the National Scientific Planning Council, you have a very impressive list of divisional representatives, members-at-large, liaison members, and I just want to draw attention to some of these societies here that are supporting work of the CMHA, the Canadian Psychiatric Association, the Canadian

an Psychological Association, the Canadian Association for Retarded Children, the Canadian Association of Social Workers, the Canadian Rehabilitation Council, the Canadian Medical Association, the College of Family Physicians of Canada, the Canadian Nurses' Association, the Canadian Corrections Association, and the Canadian Council on Children and Youth. Now, with such support of these bodies that are national in character, I really don't understand why you cannot make a strong case for funds, for adequate funds to carry out your research projects? How much support are you getting from these associations?

The Chairman: You mean financial support?

Senator Yuzyk: Both moral, supporting you in your work publicly, and in your representation, say, to MRC or other government bodies, and also financial support, if any?

Dr. Griffin: First, no financial support from these and we don't ask it, sir.

Senator Yuzyk: This is more or less honorary?

Dr. Griffin: Not honorary, these are people who assist us in helping criticize and develop our scientific program and our various projects. We also keep our relationship to these organizations through their attendance at these meetings. These are liaison members. We involve them in our deliberations so they will not feel that the Canadian Mental Health Association is grabbing something of theirs and running off by itself. We don't often collaborate as far as seeking Government support is concerned. Let me point out these organizations divided themselves into two groups; one, professional, like the Canadian Psychiatric Association, the others are lay volunteer associations, like the Canadian Association for Retarded Children, which is our sister association. They are all as anxious for Government funds as we are in the sense we are in competition although we work very closely and collaboratively with them. As far as Government support to our association, sir, we get a federal grant of \$25,000.00

Senator Yuzyk: It sounds ridiculous to me that such a small pittance would be given for this work?

Dr. Griffin: We think so too, sir.

Senator Yuzyk: I consider it vitally important to society and to Canada. What I am

wondering about is this: with the support, even the moral support of these societies, why not create a lobby in order to get funds from the Government? You have to have strong representation and you have to use methods of lobbying in order to convince the authorities. As far as we are concerned, I do not think we need convincing here.

The Chairman: I hope we are not patients yet.

Senator Yuzyk: I think we will be, but we have to deal with these hard-headed politicians in Government. I am talking about the federal and provincial governments. Why not use these associations as a lobby in order to get funds that you are so sorely in need of.

The Chairman: You make representations to the Minister of National Health and Welfare?

Dr. Griffin: We have had a meeting with the Minister of National Health and Welfare last month and he brought to that meeting his senior officials. It was an excellent meeting. The Honourable Mr. John Munro was exceedingly interested in our program and in our problems. He indicated to us, however, that we were asking him to take another look at the \$25,000,000 that he...

Senator Yuzyk: Nothing to look at, \$25,000.00 is not anything to look at.

Dr. Griffin: He said the budget was fixed for this year but maybe next year, and he suggested in the meantime that we do exactly what we are doing and work out a project which could be financed from other funds within his department.

Senator Yuzyk: Has this planning council very definite plans?

Dr. Griffin: Yes, sir.

The Chairman: And could you give us some ideas?

Senator Yuzyk: And could you give us some idea of these plans?

Dr. Griffin: We have just come from a meeting, Monday and Tuesday, where a group of 12 scientists, as I explained a little while ago, representing public health, psychiatry, sociology, public health nursing and social work, worked solidly for two days to try to design a useful project for Canada in the study and evaluation of present programs that were either in operation or could easily

be put into operation to prevent mental illness. Now, this is the first effort that has been made in this direction. We have come up with several examples.

Senator Yuzyk: This would be national in scope?

Dr. Griffin: Well, these would all have application throughout the country and just to give you one little example, we know that we can do things with children of pre-school age so that they will be able to adjust in school a great deal more effectively and with a great deal more mental health, emotional health, than would be the case if that was not done to them prior to their starting school. This is what we sometimes call cultural-social stimulation of these children and this is particularly noticeable with those children who are what we call "disadvantaged" or "deprived". They have not got the cultural stimulation, the social stimulation that children from other parts of a city might have. This is a wonderful opportunity to have an effective, preventive program starting right with those little children.

Senator Yuzyk: You have to have the co-operation of the departments of education?

Dr. Griffin: That is only part, public health too.

Senator Yuzyk: And public health.

Dr. Griffin: That is right.

The Chairman: Your first priority would be to train more people, more competent people?

Dr. Griffin: Yes, or to organize.

The Chairman: Before going at these projects...

Dr. Griffin: To deploy what we have in a slightly different way so that we can capitalize on preventive programs for a demonstration, at least.

Senator Carter: That is what worries me. You can make a case to the Minister of National Health and Welfare and probably get \$100,000 instead of \$25,000. How is that going to solve your number one problem of getting your institute going, getting your trained personnel and signing them up for ten years, say, at a decent wage?

Dr. Griffin: May I just speak to this because this is in answer to the lobby suggestion Senator Yuzyk brought up. I really feel

that we are not skilled in the use of hard-pressure methods, the lobby.

Senator Yuzyk: I think we recognize that you are too modest and too humble.

Dr. Griffin: Well, we are a little frightened by the imposing array of important people such as senators and members of parliament. We come up and speak to them. We do prepare a brief.

Senator Carter: You mean you have got an inferiority complex?

Dr. Griffin: No, no.

Dr. Cleghorn: Situational neurosis.

Senator Yuzyk: These are inhibitions, I think. I am interested in these general plans, Dr. Griffin, which of course are for the welfare of the whole country. Could you outline any other plans, one other plan anyway, so that we can get this on the record?

Dr. Griffin: Yes, sir. We know that expectant mothers are suffering now from at least two problems that detract from the mental health of the baby when the baby is born: one is a growing sense of anxiety frustration, despair and sometimes hostility about the pregnancy itself. Many, many mothers, we have discovered, do not really want to have their babies because they are frightened about the world of tomorrow. We hear so much about total obliteration.

The Chairman: You mean they took aspirin instead of the pill?

Dr. Griffin: They looked at the tabloid newspapers and saw the H-Bomb, they know that there are a lot of Bomarc missiles or something around and they feel "why should we bring more babies into this kind of world?" They know that the world now is an alarming place. It has been for them and they are worried about bringing babies into it. Now they can be helped to approach motherhood with a great deal more equanimity simply by a little reassurance and explanation and a sense of being involved with other mothers in the same kind of situation. In other words, what I am suggesting is prenatal education in groups. Secondly, we also know, and this is perhaps even more important, one of the most important factors creating disabilities and disorders in children, new born children, is a nutritional defect in the mothers. Now, this is very specific and should be easily corrected. Mothers are not getting

the right kind of food. Now, here is something that strangely enough affects the mental health and development of the children. The professor of psychiatry, at Harvard, Eisenberg, had made studies on this. So here are examples. You see they rely again on public health, nursing, social work. Our job is to bring all these people together. We say we should get at this and do something about it.

There are, to my knowledge, 2 or 3 public health doctors now in Canada who have said, "I am going to do it whether the city council pays for me to do it or not". First of all, how can we make sure that what they are doing is good, this is the most important and most difficult research problem of all, to make sure these projects are evaluated scientifically so that we know their effectiveness. After we do that we then can provide, surely, simple guidelines to running a mental health program for public health officers.

Senator Yuzyk: I have a question about social work. Social work has been increasing right across the country at a very rapid rate, and social workers deal with people, many abnormal people too, broken families, people with problems who are misfits in society. I am just wondering whether they are getting the proper training or if they are taking some psychiatry or if they make use of psychiatry in their work, in their field work and in dealing with particular cases, because they have cases to deal with that I know. I have studied that a bit in Winnipeg, in the social service audit. They send out social workers to deal with people who should be dealt with by psychiatrists, not by a social worker who has had minimum training in psychology, let alone psychiatric training.

Senator Haig: Don't say that to a social worker.

Senator Yuzyk: I am very sorry that we do not have social workers before us, but I think we can get some answers here.

Dr. Griffin: I can say that every school of social work at the university level that I know of now has intensive courses in psychiatric information and personality development. I taught this course at the University of Toronto School of Social Work myself for ten years and better people than I are now taking over and giving much more intensive courses than I was able to give. I am sure this is true at McGill.

Dr. Cleghorn: It is.

Senator Yuzyk: Social work is improving. I understand now it has eliminated the Bachelor of Social Work Degree and it is now necessary to have a Master's Degree. There is still no Ph.D Degree, is there?

Dr. Griffin: Yes, sir, there is, in Toronto.

Senator Yuzyk: That would then require psychiatry?

Dr. Griffin: Oh yes, they have to have psychiatric knowledge, but they are not psychiatrists.

Senator Yuzyk: Right, but they would be able to make some use of psychiatry?

Dr. Griffin: Yes.

Senator Yuzyk: Have we many doctorates in social work?

Dr. Griffin: Not many, but it has started this year, I think there were two Ph.D's in social work in Toronto.

Senator Yuzyk: This is the kind of program you would like to see set up?

Dr. Griffin: Yes, sir.

The Chairman: At universities. What about nurses?

Dr. Cleghorn: Nurses, certainly in Montreal, nearly all get psychiatric exposure during their undergraduate training and many of them then go on and take a much more extensive psychiatric training afterwards and many of them are absolutely invaluable, of course.

Senator Carter: What about the teachers? Should not they have some courses in this too? They are the ones that are getting the children at a very early age.

Dr. Griffin: Yes.

Senator Carter: Are teachers getting adequate training in it?

Dr. Griffin: No, sir, but again, we have had experience. I hate to keep talking about CMHA but I have been working with the association for 36 years and for a large part of that time we have been teaching teachers. Each year a selected group of teachers from all over Canada came to the University of Toronto for one academic year of intensive work in mental health. We did not try to teach them to be psychiatrists or psychologists or anything else but just good teachers.

These teachers were to return across the country and spawn new centres for training teachers in mental health. They have started but there is so little that they can do to get mental health really effectively into normal schools and teachers' colleges. This has been most difficult. This is one of the things we would like very much to do.

Senator Yuzyk: May I ask an exotic question? I have been reading paperback books on psycho-cybernetics written by American psychiatrists. Is there anybody in Canada interested in psycho-cybernetics?

Dr. Griffin: Psycho-cybernetics?

Dr. Cleghorn: Well, there is one gentleman at Edmonton who is one of these people who knows something about everything. He began as a biologist. I think he is a statistician, and so forth.

The Chairman: That is a good definition.

Dr. Cleghorn: And he has talked about cybernetics, and so on, but he generally is unintelligible to the rest of us.

Senator Haig: What is cybernetics to the rest of us uninitiated?

Dr. Cleghorn: That is a good question.

Dr. Griffin: I am sorry, it is beyond me.

The Chairman: I must declare senator Haig out of order at this stage. He should have asked this question of our research director.

Senator Yuzyk: He should have directed this to our research director, Mr. Pocock. I understood Mr. Pocock was supposed to write a confidential memorandum to you as a result of our visit to Boston. I am sorry that has not arrived yet.

Senator Carter: I would like to ask one question of either of the witnesses. Are computers being used in psychiatry in any great extent in Canada?

Dr. Cleghorn: To some extent, yes.

Senator Carter: Where, Toronto?

Dr. Cleghorn: In Toronto and at McGill and certainly in Vancouver.

Dr. Griffin: The Foothills Hospital.

Dr. Cleghorn: The Foothills Hospital in Calgary, yes.

Senator Carter: Are you making the same use of questionnaires as Dr. Kline in the Rockland State Mental Hospital?

Dr. Cleghorn: We are not making as much use as he is, and we have not got as much money.

Senator Carter: What is being done in Canada in drug therapy research?

Dr. Cleghorn: In drug therapy research Canada has been a leader because Dr. H. G. Lehmann, in the Douglas Hospital in Montreal, was the first person in the English speaking world to publish work on the new tranquilizing drugs. He has the benefit of being married to a French speaking Canadian which made him learn French. Therefore he read the French literature and he picked this up there and he started that about 1950-51 and he has maintained his leadership in the drug field and is supported rather generously by the United States Public Health authorities. There is also other good drug work going on at the St-Jean de Dieu and at the Allan Memorial and other places throughout Canada.

Senator Carter: We were talking earlier about these two categories. You feel we are not lagging in this field?

Dr. Cleghorn: We are not lagging, no.

Senator Carter: We are abreast. Are we pioneering any more work beyond what this doctor is doing?

Dr. Cleghorn: Very definitely. In many places I think we are trying out a lot of new drugs all the time and I don't think we are taking any backwater at all in that respect.

Senator Carter: In one of these categories that we were talking about earlier, neurosis—psychosis, they respond to drug therapy much better than to others which lead to certain biochemical disorders.

Dr. Cleghorn: Correct.

Senator Carter: What research is being done on that?

Dr. Cleghorn: These tranquilizing drugs are best in the psychotic disorders. They have been, in part, responsible for the diminution in patient population in mental hospitals, because these people can be controlled, their behaviour controlled, by drugs to the extent they can be allowed out of hospital whereas formerly they could not. There is the addi-

tional factor that Dr. Griffin mentioned, that the whole hospital milieu and the attitude towards these people has changed and they are given more trust and encouragement so the combination of social attitudes and drug therapy has led to a great improvement in the capacity to make these people convalescent.

Senator Carter: We put chlorine in our water supply and we put fluorine for the teeth. I read in an article somewhere that the time will come when we will put something in the water to make us all peace loving, to cut out hostility. Do you see that sort of thing happening?

Dr. Cleghorn: No.

Senator Cameron: After listening to our two excellent witnesses, dedicated, sincere and competent, and good salesmen, I am wondering why they have not sold this program more effectively over the years? Dr. Griffin, who I have known for some time, has been 36 years in this work. I am curious as to why your Association has not made more impact than it has and how it can be changed so that it can have more impact? Also the medical associations, the mental health associations that we hear so much about, they have not made an impact in getting the kind of resources of manpower or money and facilities that are obviously necessary. What can we do? What can this committee do to assist you to carry on this important work?

Dr. Griffin: You are assisting us now, sir, by listening to our story. You can assist us when we present our annual brief to the cabinet, which is immediately distributed to every member of House of Commons and Senate.

Senator Yuzyk: Would you be good enough to send it to our committee too?

The Chairman: We receive them, apparently, as members of the Senate.

Dr. Griffin: Yes. It is a fact that mental illness carries a stigma. While we can get, relatively easily, public support for work against cancer, for work against heart disease, and even polio, when it comes to mental illness, who will stand up and say, "I will support a fight against mental illness"? He won't because he would be at one once suspect—he has either got a wife or a relative who is slightly nuts, or he is himself. So nobody wants to come forward to support the Canadian Mental Health Association. In fact

thousands do. But seldom with very much money!

Now, the retarded have got grand support because the parents of retarded children say, "We will fight for our kids," and God bless them. I think they have done more for mental retardation in 10 years than we did for them in 20 before that. We were supposed to be helping the mentally retarded for several years before that. If we could get relatives of the mentally ill even to the point where they would stand up and say, "My relative is mentally ill and I want something better for that relative than he is getting now," we would get along a lot faster. But this has not come yet.

Dr. Cleghorn: If I may add a somewhat personal note, for many years I was involved in research and somehow or other got along quite happily, and more recently I have been responsible for seeing that other people have been supported. I have been, I think, relatively successful in getting some support out of various organizations, but still more recently I have had to go and try and collect money. I have visited tycoons, and so on, and I find it personally most embarrassing and most humiliating. This is saying something about my neurosis, I think—I detest doing it. I still have to go on doing it because last year we spent \$5,000.00 more than we had and we had to get it. And we got it, otherwise we would have had to discharge some of our research people. So I hope that through our combined efforts we may get to the point where we can make reasonable applications for a reasonable amount of funds for reasonable people to do what we consider reasonable work. But that has not yet arrived.

Senator Carter: Mr. Chairman, it looks, from what we have heard tonight that the avenue for funds for Dr. Griffin is the Minister of Health and Welfare, but certainly Dr. Cleghorn's program is something that has got to come from MRC or from some source like that, because it does not fit into any program of the National Health and Welfare setting up this institute and contracting to assemble and train a group of scientists. You have got the two opposite sides of the coin, but you have got to look to two separate sources for funds.

Senator Cameron: There is a third that you overlooked and which I think must come into the picture and that is a new council of social science. This must come.

Dr. Griffin: Yes, sir.

Dr. Cleghorn: And if I may say so I think it is terribly important because I do not think any one group of investigators who are applying for money should only have one place to apply. Because of prejudices and that sort of thing, an application may be turned down by one group but supported by another. When National Health and Welfare was giving plenty of money for research, and of course that is now diminishing, we had an alternative, either health or welfare. The applications we used to send to them are now dealt with by MRC, and McGill is regarded somewhat askance because of the extent of our applications for research, and I think they are embarrassed because of the proportion which we take. It simply happens that we have built up a large research organization and make big applications so that we are an embarrassment to them.

The Chairman: An embarrassment of excellence.

Dr. Cleghorn: Not always.

Senator Cameron: Has anyone in either association done anything on this, projecting to the future the role of recreation in relation to mental health? Here is a whole, huge area which might be preventive. It might be therapeutic as well.

Dr. Griffin: Leisure time, no, sir, not that I know of, at least not in our knowledge. I agree this is one other area we should explore.

The Chairman: In my limited experience in life, I am beginning to formulate a new law of behaviour which says that economic security engenders or generates psychological insecurity, and if this new law is true how can you fight it—by making people poorer?

Dr. Cleghorn: By providing them with a motivation or a devotion, shall we say, to a cause.

The Chairman: It would be difficult, I suppose.

Dr. Griffin: Occasionally we find such a person that takes an interest in mental health and becomes identified with our association and willing to share some of his or her resources with us to some extent. It is important to get the money, but I am really not as concerned about that as with the excellence of the contribution made by such a person in his or her involvement. Sometimes I am sure, this prevents a neurosis.

Senator Cameron: Are your associations' donations tax deductible?

Dr. Griffin: Yes, sir.

Senator Yuzyk: I would like to make an observation here. Your work has so many facets of interest, not only to the public but to government, to society, to professional people, that I am wondering why you don't make systematic use of the mass media or whether you plan such a thing, that is making use of writers and journals and magazines, radio, television. Have you any committee or people who pay attention just to public relations?

Dr. Griffin: Yes, sir, we have indeed. We do this and we are getting a lot of time on the media. As a matter of fact two years ago one of the leading advertising firms in Canada gave us more than \$1 million worth of time and talent to help mount a public education program. We were not, unfortunately, able to utilize this as fully as we should have or could have because when everything was all

set to go to the newspapers, for example, and to some other media, they refused to carry the ads—which had to be carried free as a public service. It was against their policy, they said. So there are obstacles all along the way. We have to overcome them somehow.

The Chairman: Well, it is about 10.00 o'clock, gentlemen, and I want to adjourn now, and you have to go to perhaps some more important duties and responsibilities. We have enjoyed our meeting with you and we are certainly convinced, as was said before, that you are representing a very important profession and that you will have an increasing role to fill in our new society. So we hope that eventually we will be able to help you more than you have been assisted up to now.

Dr. Griffin: Thank you very much.

Dr. Cleghorn: Thank you for listening, sir.

The Committee adjourned.

APPENDIX 132

SUBMISSION TO THE

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

BY THE

CANADIAN PSYCHIATRIC ASSOCIATION

Suite 103
225 Lisgar Street
Ottawa, Ontario

April 15, 1969

C O N T E N T S

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Appendices:

1. The Canadian Psychiatric Association - Objects
2. The Canadian Psychiatric Association - Board of Directors

I PREFACE

The Canadian Psychiatric Association as a professional society of physicians interested in the study and practice of psychiatry, is pleased to be able to respond to the invitation extended by the Senate Special Committee on Science Policy that a submission should be presented for consideration.

The Board of Directors⁽¹⁾ at its meeting held on February 3, 1969 in Toronto decided to ask Professor Robert A. Cleghorn, M.D., D.Sc., F.R.C.P.(C), the Chairman of its Committee on Research to prepare this submission. The Board is grateful to him for his work in preparing it, and is confident that it represents the views of the majority of the members of the Association. Dr. Cleghorn is Professor and Chairman of the Department of Psychiatry, McGill University, Montreal, Director of the Allan Memorial Institute and Psychiatrist-in-Chief of the Royal Victoria Hospital, Montreal. What is perhaps even more important he was chairman of the Medical Research Council Assessment Committee with respect to Psychiatry. The report of this Committee recently appeared in the volume entitled "Canadian Medical Research: Survey and Outlook" (MRC Report No. 2, September 1968).

(1) See Appendix 2

In preparing the present submission, Dr. Cleghorn has drawn considerably from this report.

The Canadian Psychiatric Association now presents this submission to the Senate Committee in the hope it will prove helpful in the Committee's study of science policy in Canada.

Respectfully

R. J. Weil, M.D.

II SUMMARY OF RECOMMENDATIONS

1. The most urgent need in psychiatric research is the stimulus and opportunity for well trained clinicians to undertake the study of clinical problems with a scientific scrutiny. (page 5, para 2)
2. There is need for provision of more adequate scholarships or bursaries for young trained psychiatrists to continue and take research training. (page 7, para 4)
3. In addition to emphasizing the importance of research and scientific method in the study of clinical problems more emphasis is needed in the study of alcohol and drug addiction and in forensic psychiatry. (page 7, para 5).
4. University departments of psychiatry are not sufficiently or securely financed to permit appropriate development of psychiatric research. The basic sciences and clinical medicine are comparatively much better off. (page 8, para 6)

III PSYCHIATRIC RESEARCH IN CANADA

1. Psychiatric research in Canada was incidental and fragmentary before World War II. Since that time, Canadian Departments of Psychiatry associated with the universities have developed rapidly, in part associated with the emergence of psychiatry from mental hospitals and the establishment of units in general hospitals. Teaching at the undergraduate level began to be organized in a modern fashion subsequent to World War II and post-graduate training courses were established. Research, which had pushed medicine into a new era, in the earlier decades of the century had affected psychiatry very little. The emergence of the shock therapies in the thirties gave new hope and fresh therapeutic weapons, but little organized research was done until the establishment of the university departments in the forties and fifties. One of the early difficulties was the inadequate supply of trained investigators in the field. In order to correct this short-coming, two of the older centers brought in experienced research workers from basic disciplines to establish laboratory investigation with the anticipation of cultivating a climate of opinion in which clinical research could grow. A few clinicians, by virtue of their own inclinations and hard work, made themselves familiar with the methodology of research and undertook praiseworthy programs. In the past fifteen years, the pace of research in psychiatry has accelerated, but it is quite obvious to those doing the survey of psychiatric research in Canada that the best work in the broad field of psychiatry was being undertaken by

those familiar with the most precise techniques of the mature disciplines of biochemistry and physiology. Most of these individuals did not have an M.D. degree. Few psychiatrists have had the time, inclination or financial support sufficient to familiarize themselves with these specialized disciplines, many of which have only a very peripheral bearing on the major problems of psychiatry.

2. The most urgent need in psychiatric research is the stimulus and opportunity for well trained clinicians to undertake the study of clinical problems with a scientific scrutiny, applying critical techniques to the solutions of the problems involved. Many of these areas still are those of the so-called 'soft data', where methodology has to be worked out in order to tackle the problems in a critical, scientific manner. The lag in the development of research in psychiatry is inherent in the discipline itself, rather than in the lack of the people involved. Psychiatry borders on a large number of the behavioural sciences, such as psychology, sociology and anthropology, and draws from them points of view and methods of approach which are of great importance, but in many respects lack the precision available in the basic sciences of biochemistry and physiology.

3. The training of clinical research workers in psychiatry is still a very vexed problem. Nowhere has anyone come up with a system which will, without fail, produce a productive research scientist in this clinical field. A few young men have taken time off from either their clinical duties or after their clinical training has been completed to take specialized training in neuro-physiology or in bio-chemistry or even in psychology and then returned with these skills to the study of a specialized problem in, as a rule, limited areas of psychiatry. The number who have done this is relatively small and for reasons which are fairly obvious. They will, by the time they have finished their clinical training, have reached the age of about thirty and frequently have families to support. Well paid opportunities are available in clinical psychiatry itself and for these young men to turn their back on the good emolument and the personal satisfaction of dealing with appreciative patients in order to undergo the years of deprivation and small salary while they are getting further training, is more than they can face. Here is one area which might be tackled more vigorously, namely the provision of more adequate scholarships or bursaries for young trained psychiatrists to continue and take research training. As it is now, the medical research fellowships are rarely adequate to support young psychiatrists for the time necessary to gain the kind of experience to transform them into investigators.

4. Another factor of major importance which should be clearly recognized is that the character structure of a young man doing research in psychiatry is almost, of necessity, odd or exceptional. He must have a devotion to the solution of scientific problems in this field, denying at the same time the usual affiliation to any one of the several dogmas which plague psychiatry. If it is necessary to emphasize an optimistic note at this point, it should be stated quite clearly that there are more young psychiatrists demonstrating an interest in research now than formerly and they are allying themselves with inter-disciplinary workers from other fields, such as bio-chemists, sociologists and psychologists, and as they work acquire some of the expertise which is necessary to qualify them as independent investigators.
5. No attempt will be made to itemize the current status of psychiatric research in detail, as this has been done in the Medical Research Council report. It might be well to point out, however, that there is an inadequate amount of work being done in the field of alcohol and addiction, while that in bio-chemistry and psycho-pharmacology seems to be proceeding satisfactorily. One might add to this psycho-physiology. In the field of psychology, in which Canada has been rather prominent because of some of its leading investigators, there is insufficient pay and many such young investigators have been

attracted to the United States by better remuneration. Money is also badly needed in the area of forensic psychiatry, because this field has not yet, except I think at the University of Toronto, been properly incorporated into the university structure. It needs little emphasis on our present social problems to indicate the tremendous importance of this area.

6. In conclusion, one should say that psychiatric research in Canada needs financial support from both provincial and federal government sources. Most universities are not sufficiently well financed as far as research is concerned to give the support in this area which is needed. Support is more easily forthcoming for the established research areas in the basic sciences and in medicine, where the discreteness of the problems can easily be demonstrated. It should be pointed out, however, that the problems being attacked by psychiatry are of much more immediate relevance to the health and social organization of Canadian citizens than are those of the basic sciences and even of medicine. It has to be recognized and taken into account that at the present time many of the methods which psychiatry uses in its study have not got the degree of satisfactory clarity

as have the others mentioned. We have to be prepared to spend money without an immediate return to support even some rather speculative studies, in order to (a) train and (b) examine the problems which face us in the social science and behavioural disciplines today.

APPENDIX I

CANADIAN PSYCHIATRIC ASSOCIATION

OBJECTS

1. To further the increase of psychiatric knowledge and to encourage and develop research into the causes, treatment and prevention of mental disorders.
2. To establish an organization on behalf of the psychiatrists of Canada for their mutual benefit, for the exchange of scientific information and for the promotion of their professional welfare and usefulness.
3. To represent the members of the Association in their relationships with the Government of Canada, provincial and municipal governments, universities, medical associations, and other associations, organizations and bodies with which the psychiatrists of Canada from time to time may have relationships.
4. To encourage psychiatric education in universities, hospitals and related institutions and the establishment of mental health clinics, demonstration units and other facilities for the advancement of psychiatric education, and for the improvement and extension of the treatment of mentally ill persons.
5. To publish journals and other literature for the dissemination of psychiatric knowledge to medical practitioners and others.
6. To receive bequests, donations, grants of money and to raise monies by membership fees, public subscription or in any other manner that is not contrary to the laws of Canada or any of the provinces for the carrying out of the objects of the Association.

APPENDIX II

CANADIAN PSYCHIATRIC ASSOCIATION

BOARD OF DIRECTORS 1968-69

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APPENDIX 133

SUBMISSION TO THE

SENATE SPECIAL COMMITTEE ON SCIENCE POLICY

by the

CANADIAN MENTAL HEALTH ASSOCIATION

National Office

52 St. Clair Avenue East

Toronto 7, Ontario

March 29, 1969

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1. CMHA - Background and objectives
 2. CMHA - National Scientific Planning Council
 - National Board of Directors
 3. CMHA - Research and Technical Studies Program

I PREFACE

The Canadian Mental Health Association commends the Senate Special Committee on Science Policy for its determination in exploring the problems of scientific endeavour in Canada. It welcomes very much the invitation extended to make this submission.

The brief here presented was prepared with the full participation of the National Scientific Planning Council of the Association and ratified by the National Board of Directors at a meeting on March 29, 1969. The membership of the Council and the Board is listed in Appendix (2) of this submission.

It is the sincere belief of this Association that mental and emotional disorders constitute a major threat to the survival of this country as an efficient, effective and vigorous nation. That the solution to the problems of the control and prevention of mental disorders and the promotion of good mental health still elude us is no secret. We believe that such

solutions can be reached only through a vigorous, carefully planned program of scientific research in many different fields. We believe further in the need not only for scientific research but in the necessity for quite interpretative scholarship. There are times when the difficulties of implementing the known facts into useful social and medical policies is far greater than the difficulties of discovering the facts in the first place.

It is with this view and in the hope that our deliberations, conclusions and recommendations will be helpful to the Senate Committee that this submission is respectfully presented.

J. F. O'Sullivan
National President
The Canadian Mental Health Association

II SUMMARY OF RECOMMENDATIONS

1. Mental and emotional disorders are causing a serious drain on the effective manpower in Canada and a major loss to the national economy. In order to develop an effective program for the control and prevention of these disorders we must plan for the immediate establishment of appropriate scientific research effort. (See pages 8 - 11).
2. An adequate research program will require the immediate provision for the recruitment, training and establishment of talented research scientists who will devote themselves to careers in fields related directly to mental health and mental illness. (See page 16).
3. Basic salaries should be provided for these scientists which are adequate for their needs and comparable to the remuneration available to their colleagues who are engaged in other

types of research (e.g. the physical sciences), or in clinical teaching or private practice. (See page 16).

4. In addition to encouraging the establishment of career research scientists in this field every effort should be made to encourage the development of a spirit of enquiry and research among those who are involved mainly in the helping services and treatment practices in connection with the mentally ill (psychiatrists, family physicians, social workers, clinical psychologists, psychiatric nurses, etc.). (See page 15)
5. There should be a known government budget committed and available to promote the research requirements in the mental health field. Such a fund should be utilized to help establish the career research scientist, to provide project grants for work on specific problems and to purchase equipment. The career research scientists would provide the senior cadre of leaders required for

establishing adequate training and development programs for research personnel, while the project grants will provide flexibility for the program including encouragement for work in fields which are being neglected.

(See page 18).

6. Funds for research, scientific and technical development in the mental health area should be stipulated even if they are integrated into general health science research funds. Only in this way can we be sure that appropriate encouragement is directed to this sensitive and difficult area (see page 18)
7. Certain areas of investigation require immediate emphasis and special encouragement. Particularly important are studies in clinical and preventive aspects of psychiatry and studies in the behavioural sciences as related to mental illness and health. (See pages 12 - 14)
8. Particular emphasis should be placed on the value of multi-discipline research teams which

bring the biomedical, sociological and psychological professions and disciplines together in a concerted attack on the seemingly vague and so-called soft areas of mental health research. Such areas, for example, would include problems relating to cultural, social and emotional impoverishment and deprivation. (See pages 18 - 19)

9. Where there is general agreement about the importance of a difficult scientific problem which demands quick resolution, it would be advantageous, in terms of both economy of effort and the speed with which results can be obtained, to establish collaborative studies involving several research centres each providing a team working on the same area of concern. In such cases it might be useful to establish a central data processing centre into which the data from all the collaborative centres could flow for analyses. (See page 19)

10. The establishment of some kind of federal research planning, funding and evaluation centre should be given careful consideration. This centre should

take into consideration that mental health research is by no means entirely medical but must involve other disciplines, particularly the social and behavioural sciences. It should provide an information centre and clearing house for scientific data for Canada in the mental health sciences (See pages 19 - 20).

III MENTAL HEALTH AND ILLNESS

1. Difficulties in definition.

Superstition, misconception and ignorance have contributed to the substantial stigma which, while slowly lifting, still clings to mental disorders of all kinds. Recently there has been a growing acceptance of the obvious fact that mental and emotional disorders are in fact symptoms of illnesses or indicators of deviant behaviour which must be understood and dealt with in the context of the sociological, psychological and biological scientific disciplines. The medical discipline itself is rapidly expanding its frame of reference so that it relates not only to the biological, biochemical and physiological sciences, but increasingly also to the sociological and psychological sciences. However, in spite of rapid advances in these fields, it still remains virtually impossible to arrive at exact widely accepted definitions of the terms "mental health" and "mental illness".

2. Extent and Cost of Mental Illness.

Nevertheless, there is now no doubt that the mental illnesses and disabilities and those somatic (physical) illnesses and disabilities which are directly or indirectly related to mental and emotional disorders are far more common than was formerly believed to be the case. They represent a very serious threat to our most precious natural resources - our national human potential. It is no longer sufficient to refer only to the more than 60,000 patients in our Canadian mental hospitals. These represent only some of the most acutely disturbed and very disabled patients. When we consider in addition those who while seriously disturbed are able to carry on in the community, we must include very large segments of the population. Canadian studies have shown that as many as 25% - 30% of all adults have had a history of serious difficulties of this kind, - mental and emotional disorders - causing tangible disability.⁽¹⁾ Such people are in need of

(1) Leighton, et al. The Character of Danger: The Stirling County Study of Psychiatric Disorder & Sociocultural Enjoyment. Vol. III Basic Books, N.Y. 1963

professional medical and psychological treatment. There is evidence to show that illnesses of this type in terms of direct and indirect expenses and economic losses, cost Canada nearly 700 million dollars a year.⁽²⁾

3. Need for more exact knowledge.

With our difficulty in finding an exact definition of mental disorder, but with growing certainty of its widespread nature and its enormous cost to the nation, it seems clear that there is need for an immediate and major effort to gain the necessary knowledge which will lead to its effective control. While mental illness is not usually regarded as a major cause of death (as is cancer and heart disease, for example) it is certainly true that thousands of people in Canada each year commit suicide. Apart from the official figures (currently about 4,000 per year) it is almost certain that another large group of fatal accidents are really suicides although not

(2) Mitchell, W.R. Appendix 9 of Submission by CMHA to the Royal Commission on Health Services, 1962

recorded as such. In addition, one must acknowledge that there are many different kinds and degrees of death. Mental illness frequently brings the patient to a terminal state where, although biologically alive, he is socially and productively dead. It is obvious that mental and emotional disorder undermines and devitalizes the nation's health in many costly ways. It must be countered with all the vigour and resources at our command. The very fact that mental illness is not a very popular public "cause" makes it all the more insidious. And for this reason too the closest of cooperation should exist between the government and the voluntary mental health organization. Only the most effective public education programs and the most carefully developed social action programs will provide the necessary public appreciation and support for the essential scientific planning and research expenditures.

IV THE STRONG AND WEAK AREAS OF RESEARCH

1. In a review of present psychiatric research in Canada, Cleghorn (3) has pointed out that certain areas of investigation are reasonably well developed. These relate particularly to the biological areas including pharmacology, biochemistry and neurophysiology and have lead to some significant therapeutic successes. For example the disease caused by syphilis of the brain and central nervous system (G.P.I) has almost disappeared. The advent of Electro Convulsive Therapy has improved the prognosis in most cases of acute depression. The new drugs (tranquilizers, anti-depressants, etc.) have proven to be invaluable. The new discoveries of the field of genetics is opening a new appreciation of hereditary and constitutional disorders involving personality and behaviour. There has even been some promising new work in the field of individual and group psychotherapy.

(3) Cleghorn, R. A. Submission to the Senate Special Committee on Science Policy on Psychiatric Research in Canada. Canadian Psychiatric Association, March 1969.

2. However there are also some weak areas in which very little work of excellence is proceeding. For example, sociology, psychology and the behavioural sciences while deeply involved in research on other problems are not notably producing studies in the field of mental illness and health. There is a growing conviction that the great social issues of our time are directly related to increasing stress and tension with a concomitant increasing number of people developing symptoms of "a breakdown in living". These social issues include poverty, housing, population growth, unemployment and (probably) the increasing amounts of leisure time. That these contribute to social and community breakdown is an assumption which has now been reasonably well documented. Closely related, of course, are the breakdown of moral and social values and family disintegration. Problems arising because of alienation and deprivation are common precursors to mental and emotional disability. An increasingly serious factor in mental disorders and

one commonly related to deprivation is faulty nutrition, especially in expectant mothers and very young children. This emphasizes the importance of joint biological and sociological studies. All these areas have been recognized as potential and actual etiological factors at the root of much of the nation's poor mental health. Exactly how they can be controlled and corrected, and the nature of preventive programs are enormously important problems challenging the medical, social and political scientists.

3. In the Canadian Psychiatric Association brief (3) reference has been made to the importance of establishing a number of full time research scientists on adequate salaries who could provide the necessary stimulation and inspiration for the recruiting and training of young scientists interested in the mental health field. There is some evidence to show that the primary problem in ensuring on-going exemplary research is not only the absence of money nor even the absence of good ideas for research. The major problem is the lack of a

sufficient number of well trained career research scientists. The potential effect of such a cadre of scientific leaders extends far beyond the production and publication of research papers. It could go far to raise the level of scientific interest and a spirit of enquiry among students and young practitioners. This is particularly true for the medical profession including clinical psychiatry. The Association is flatly opposed to the suggestion recently made⁽⁴⁾ that Canada should cut down on medical and related research in order to place greater emphasis on the training of more doctors. The result would be an inevitable deterioration of the standards of medical professional excellence to those of medical technicians.

(4) Melvin, James - in presentation to the Commission on Relations between Universities and Governments (speaking as President of the Ontario Medical Association).
Toronto Daily Star. April 2, 1969.

V A CANADIAN RESEARCH PROGRAM IN MENTAL HEALTH

1. The first task then in drafting a research program in the field of the mental health sciences is to find, train and support an adequate number of excellent scientists in various interlocking fields of professional endeavour. Especially important is the development of clinical psychiatrists who have a good grounding in one of the social sciences and are thoroughly trained in the design and methods of research.

2. The next task is to provide these scientists with sufficient financial security so that they have "creative freedom". To this end provision should be made to remunerate these scientists with adequate fellowships or bursaries quite apart from the so-called "project grants". These project grants are designed to pay for research on a sort of contract basis - so much money for so much new knowledge about a certain problem. This sometimes fetters the scientist. He may well find that the project which looked promising

at first is valueless, while something else quite unexpected and exciting is discovered. This new idea however cannot be explored because the grant is tied to the original project. Furthermore the timing of these project grants is often frustrating. The discovery of vital information and the operation of university departments seldom coincide with the government fiscal year! In spite of this research project grants are useful. While the career "in-line" scientists add constancy and stability to the scientific program, the project grants add flexibility. They are useful for encouraging those engaged in the helping or treatment services to develop research interests. And they provide a means to stimulate investigation in otherwise neglected areas. Another special use of research funds relate to the need for covering the special cost of university administration in connection with research programs including the cost of essential scientific equipment.

3. In order to ensure adequate development of scientific endeavour in the mental health field a known and committed government budget should be established. While this budget could be included with the present government programs for financing basic and applied research (5) it should be possible always to assess its use in order to insure that the field is not neglected in comparison to other often more "fashionable" areas of investigation. The fund must have a high priority if we are really sincere in our belief in the importance of protecting and enhancing our human resources. Better that we delay developments in other fields such as research in new weaponry rather than restrict our efforts in this essential area.

4. Encouragement should be given to the development of research teams representing the collaboration of different disciplines. This is becoming more common now than it used to be. It needs to be expanded vigorously. The cross-fertilization of the

(5) The present Medical Research Council, the Public Health Research Fund, etc.

collaborating disciplines is stimulating and is increasingly essential for progress in these "soft and ill-defined" areas of research.

5. In selected areas of research and with reference to certain difficult problems (the study of schizophrenia, for example) there should be encouragement for the development of a number of collaborative studies. In such a project several different research centres work together on the same problem, pooling or exchanging data. In this way adequate amounts of data can be collected quickly, errors and false starts detected sooner, and results obtained more readily. The use of centralized data analysis for several centres working on the same problem would be practical in certain types of studies.
6. It is recommended that the appropriate institution in which research in this field can best be developed is the university with well developed faculties of medicine (including psychiatry), social work, nursing and the social sciences. The

advantages of having some sort of national mental health research institute should be closely examined. This need not be a full-time government department but rather an organization comprising representative scientists from several disciplines in several universities. The Medical Research Council is an admirable example of one such an institution. The Canada Council is another. The MRC has already begun to support research in the psychological and sociological fields. In fact the change of its name to the Health Sciences Research Council has been suggested ⁽⁶⁾. Nevertheless, it may well be advisable in view of the extent, ramifications and difficulties in the field of mental health and illness to establish a separate Research Institute for Mental Health. Such an institute could serve a very useful role in promoting the ideas and policies contained in this brief as well as serving as Canadian Mental Health Information Centre and Clearing House.

(6) Medical Research: Survey and Outlook
MRC Report No. 2. Sept. 1968

7. The Canadian Mental Health Association has endeavoured in modest ways during the past ten years to develop and demonstrate all these ideas in connection with mental health research in Canada. In our view there is now sufficient evidence and a substantial body of supporting opinion to warrant governments at all levels to take appropriate and necessary action.

THE CANADIAN MENTAL HEALTH ASSOCIATIONNATIONAL BOARD OF DIRECTORS 1968/69

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March 4, 1969.

APPENDIX (1)

THE CANADIAN MENTAL HEALTH ASSOCIATION

BACKGROUND AND OBJECTIVES

The Association was organized in 1918 and legally incorporated in 1927. It celebrated the 50th Jubilee last year.

The objectives of the Canadian Mental Health Association are still as valid today as they were in 1918:

- (1) To improve the public understanding and attitude towards mental illness and the mentally ill.
- (2) To improve treatment services for the mentally ill.
- (3) To promote the prevention of mental illness and the improvement of public mental health.

The Association has a national office, provincial division offices in all provinces and some 160 local and county branches. It has a paid up membership of over 35,000 members.

APPENDIX (2)
THE CANADIAN MENTAL HEALTH ASSOCIATION

NATIONAL SCIENTIFIC PLANNING COUNCIL
1968 - 1969

Chairman: Dr. Keith Yonge, Psychiatrist, Edmonton

CMHA Divisional Representatives:

Dr. Anthony Marcus, Psychiatrist, University of British Columbia
Mr. G. E. McLellan, CMHA, Alberta Division
Dr. M. Demay, Regina General Hospital, Regina
Dr. Harry Prosen, Winnipeg General Hospital, Winnipeg
Dr. George Jenkins, Mental Health Clinic, London
Dr. Paul Christie, Queen Street Mental Health Centre, Toronto
Dr. Alastair MacLeod, Mental Hygiene Institute, Montreal
Dr. Gilles Lortie, Institut Albert-Prévost, Montreal
Dr. R. G. Forsythe, Saint John, N.B.
Dr. Noel Murphy, Eastern Counties Mental Health Centre, N.S.
Dr. M. N. Beck, Mental Health Clinic, Charlottetown
Dr. E. O'B. Freeman, St. John's, Newfoundland

Members-at-Large:

Dr. Robert Cleghorn, Chairman of Research Committee, NSPC
Allan Memorial Institute, Montreal
Dr. John Dewan, Ontario Mental Health Foundation, Toronto
Dr. R. O. Jones, Dalhousie University, Halifax
Mr. R. E. Jones, Metro. Toronto School Board, Toronto
Dr. Angus M. Hood, Director, C.M.Hincks Treatment Centre,
Toronto
Dr. Lucien Panaccio, Hôpital Saint Jean-de-Dieu, Montreal
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Dr. K. Ferguson, Psychologist, Clarke Institute, Toronto
Dr. Bruce Quarrington, York University, Toronto
Dr. C. A. Roberts, Clarke Institute of Psychiatry, Toronto
Mr. Fred McKinnon, Department of Public Welfare, Halifax
Prof. Nathan Epstein, McMaster University, Hamilton

Liaison Members - Professional Associations:

Dr. J.D. Atcheson, Canadian Psychiatric Association
Dr. J. A. Tuck, Canadian Psychological Association
Dr. Allan Roeher, Canadian Association for Retarded Children
Dr. Rita Lindenfield, Canadian Association of Social Workers
Dr. Keith Armstrong, Canadian Rehabilitation Council

Dr. David A. Stinson, Canadian Medical Association
Dr. M. Stock, College of Family Physicians of Canada
Mrs. A.W. MacLeod, Canadian Nurses' Association
Mr. W. T. McGrath, Canadian Corrections Association
Dr. Margery King, Canadian Council on Children & Youth

The Federal Government:

Dr. Allen Davidson, Mental Health Division, Department of
National Health and Welfare
Mr. Carl Birchard, Department of National Health and Welfare
Dr. Richard Splane, Welfare Assistance and Services,
Department of National Health and Welfare

March, 1969

APPENDIX (3)

THE CANADIAN MENTAL HEALTH ASSOCIATION

RESEARCH and TECHNICAL STUDIES PROGRAM

The current program emphasizes four areas of endeavour:

- (1) Improved care and treatment for mental hospital patients
- (2) Aftercare and rehabilitative services
- (3) Treatment, education and services for emotionally disturbed children
- (4) Community mental health services

The Association carries on its work in these areas through four kinds of program activities:

- (1) Research and technical studies
- (2) Social and community action to improve legislation and governmental programs
- (3) Volunteer services to patients and the community
- (4) Public and professional education about mental illness and health

The Research Fund of the Canadian Mental Health Association was established several years ago in order to stimulate the discovery of new knowledge about mental illness and health and to encourage talented young Canadian scientists to develop research careers in this country. This was designed in such a way that the program did not overlap with research support programs of the federal or provincial governments (MRC, DNH&W, OMHF, etc.).

Each year a singularly talented scientist was given a substantial award from this fund with very few strings attached.

This was designed to free his time for creative work in his chosen field. To date the results have been most satisfactory. Rev. Dr. Noel Mailloux, Centre for Research in Human Relations, Montreal, has demonstrated a method for reducing dramatically the recidivism in young delinquents. Dr. P. McGeer (Vancouver) has developed important new knowledge on brain biochemistry. Dr. Robert Pos (Toronto) has studied the importance of isolation from both internal as well as external stimuli in the cause of mental disorders. Dr. A. Barbeau (Montreal) has made a spectacular breakthrough in the treatment of Parkinson's disease as part of his studies on schizophrenia - and so on. As a departure from our regular policy in 1966, CMHA initiated collaborative re-testing studies in twelve centres on the value of niacin in the treatment of schizophrenia. Results of this work will be shortly available and may well be of world wide significance.

The 1969 award was made to Dr. Robert Hare, Associate Professor of Psychology at University of British Columbia. His interest lies in the learning patterns of psychopathic and sociopathic persons. His work will be an interesting supplement to Mailloux' contributions.

In addition to the research award, the CMHA through its Research Fund sponsors technical studies and reports. Among those already completed are the reports on psychiatric services in Canada (MORE FOR THE MIND) and legislation as it pertains to psychiatric illness (THE LAW AND MENTAL DISORDER - Parts I, II and III). The third part of the report on this subject has just been published.

New technical studies planned or underway at present include considerations of Mental Health in Public Health, the problem of Student Unrest in educational institutions and the role of Volunteers in Elementary Schools. In addition, the CMHA is acting as a supervisor and trustee of an important research on the criminally insane at Oak Ridges Hospital in Penetanguishene, Ontario. This has been funded by the Donner Canadian Foundation through the CMHA.

BINDING CEC... APR 13 1970

